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समकालीन प्रविष्टान
HUN BOY
HARM...
OF... ALT LAKE
...LCB...

ENVIRONMENT AND DEVELOPMENT

(VIRTUES OF INDIA'S VEGETATIONS)

(VOLUME 1)

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INTRODUCTION

Afforestation is a global programme to combat green-house effect. As a part of same planet we are also aware of this aspect of environmental crisis, hence afforestation has become our national priority too. Our forest departments are alerted and plantation programme has been taken up on priority basis, although depletion of forest also continues as before either legally or illegally.

Simultaneously we are also asking forest departments to increase forest revenues and pressurising them for more and more internal resource generation. Priority of afforestation and priority of revenue earning led the forest departments to go for commercial plantations. Instead of choosing the traditional plants of the region, thrust was given on commercial plants like teak etc., or fast growing plants like eucalyptus etc. without assessing whether they are really suitable for environment of the area. Fact that traditional plants remained in those areas, for centuries, there must be reasons connected with environment for their growth and sustenance. On the other hand it is reported that the new commercial or fast growing plants influenced our environment often too adversely. For example a particular variety of eucalyptus planted in a number of States in North India caused fall of Water table.

CHIPKO and APPIKO movements recently has highlighted this aspect too in their agenda while Appiko movement successfully prevented felling of traditional plants and trees, particularly in Karnataka, Chipko movement fought against commercial plantations. Therefore there is need to plan what exactly should be our future modus operandi vis-a-vis afforestation, forest revenue and environment.

It is needless to say that even our traditional plants and trees which are usually considered as non-commercial also can be made commercial if we know what exactly it gives to us. Many cases we either do not know or knowingly we do not utilise the wealth that these plants can give us. In many cases, instead of assessing our own technology or wealth we imitate Western line of thought without even reviewing its applicability. Even those plants which we cultivate we exploit only a part of its wealth while balance is either thrown or devalued.

All the above aspects are thought over and accordingly in this book a number of our own traditional vegetations are discussed reviewing what they can give us and how we can plan our future development utilising this wealth which was neglected so far. While discussing each such plant in each of the Chapters that follows, environmental aspects are also taken care so that all the problems that we anticipate are taken care. There are however many more vegetations than what will be discussed here which may be taken care by many more scholars but this book shall serve as a beginning of the total effort.

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G.K. GHOSH

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CHAPTER 1

MAHUA

Till recently Mahua was known for its pleasing aroma only. Mahua has been catering the requirements to the tribals only in its places of occurrence viz forest belts of Bihar, Orissa, MP and West Bengal. For instance they make their brew (country liquor) out of its flowers and fruits they consume oil as an item of food and fruit as vegetables.

The growing needs of edible oil against their scarcity prompted search for additional vegetable oil resources and Mahua came into light among others. Oil technologists visualised a situation where Mahua oil could replace cocoa butter. Later they toyed with the idea of its use as edible oil and finally its application as a good soap stock gained currency. Use of Mahua oil as an edible oil is nominal except for its induction in Vanaspathi of about 5 per cent of the oil stock. However Mahua oil is extensively used in Laundry soap manufacture although it has yet to make a dent as an edible stock for consumption. In this chapter an attempt is made to assess the salient features resting on the efficient methods of processing of Mahua fruits, flowers, seed, oil cake etc., to ensure better values.

Known as *Bassia Latifolia* and *Madhuca Longifolia* in Botanical nomenclature, Mahua is found all over the country mostly in U.P., M.P., Bihar, West Bengal, Orissa, Andhra Pradesh, Kerala, Karnataka etc. The estimate oil Kernal is part anywhere around 5,19,650 M.T. in the country out of which only 75,000 M.T. are brought into use due to limitations in its applications in the industry. One of the main reason for the limited use has been its acceptability as an edible oil which is yet to be established. Secondly soap manufactures are yet to accept the Mahua oil as a potential source for their soap stock, to be specific the toilet soap stock.

Properties of oil

Colour	- Pale Yellow
Consistency	- Plastic
Refractive index at 40°C	- 1.452 to 1.462.
Iodine Value	- 58 to 70
Saponification value	- 187 to 196
Unsaponifiable matter	- 1.0 to 3.0%
Free fatty acid	- 5 to 30%

Fatty acids

Palmitic	- 16 to 28.2%
Stearic	- 20 to 25.1%
Linoleic	- 13.2%
Arachidic	- 0 to 3%

Glucide Composition

	Mol %
Fully saturated	1.2
Mono Oleo	27.8
Di-Oleo	71.0
Others	2.69

Mahua oil is characterised by the presence of a large proportion of palmitic acid in it. It shares this special characteristics in common with three other fats viz. Cocoa butter, cotton seed oil and mutton tallow. Due to these characteristics perhaps it was initially thought that Mahua oil will be an ideal substitute for cocoa butter. But by virtue of the presence of high percentage of the free fatty acid it remained unfit for edible proposes. Keeping this in view Dr. J.G. Kane carried certain experiments on Mahua oil in three states (a) Refining (b) Hydrogenation and (c) solvent Crystallization.

In the first stage the oil was treated with 90 per cent alcohol at room temperature in the ratio of alcohol : oil 4 : 1. Three

successive treatments reduced the acid value of the oil from 21 to 1.5. This oil then deacidified by aqueous alkali.

In the second stage the oil was hydrogenated using 1 per cent Rency nickel or 0.5 per cent wet reduced catalyst. Rates of Mahua oil were studied at 130°C. Straight hardened products having iodine value from 25 to 45 were tested for their melting range and micro-penetration and were found to be similar to mutton tallow. For the production of Cocoa butter substitute, the oil was further hardened to iodine value of 23 and melting point 57°C. On analysis it was found to contain 6 per cent isoleic acid, 72 per cent saturated acid and 23 per cent oleic acid.

At the third stage the oil was solvent crystallised using acetone and petroleum ether as solvent at 15°C. At solvent fat ratio 4/1, oil thus obtained with iodine value 37 and melting point 41.7°C.

However, inspite of the above treatment the fact remained unfit for edible propose. As experienced by Dr. M.B. Ichapuria of Tatap Oil Mills Ltd., Tatapuram, 2 to 3 per cent unsaponifiable matter which eventually remains in the soluble portion during crystallization will render it unfit for edible purposes. Above treatment by Dr. Kane only takes care of high free acid. Besides the above observations Dr. N.N. Godbole watched during his work on Mahua oil at the Banaras Hindu University that high content of unsaponifiable matter made the oil rancid rapidly. This process of auto oxidation not only gives bad odour but attacks the perfume already in the soap. This perhaps explains the reason as to why Mahua oil is not used widely even today but used only in Laundry soap manufacture. This unsaponifiable matter having iodine value of 30 is identified as the main culprit for better use of the oil and this can be separated from the oil by three stages viz. (a) phosphoric acid treatment, (b) distillation and (c) Earth bleaching.

The Process

Equipments needed :

- (1) Storage tanks with steam heating arrangements
- (2) Two pressure vessels

(3) Filter presses

In case of the first pressure vessel which will be used for distillation and phosphoric acid treatment it must be provided with both open and closed steam heating arrangement. It should also have double stage vacuum system viz. ejectors at first stage and augmentors in the second. It must have arrangements for using phosphoric acid under vacuum. In case of second pressure vessel which will be used basically for bleaching of treated oil should have single stage vacuum system with the help of a ejector with a closed coil for steam heating of oil. It should also have arrangements to suck dry bleaching earth under vacuum.

After the oil is taken in the first pressure vessel the first stage vacuum raised and phosphoric acid (Commercial 85%) 0.1 per cent on oil basis is sucked in. The oil is then heated upto 120°C at 25 inches vacuum by the help of closed steam. On achieving the above temperature the second stage vacuum system should start and the oil is then heated with the help of open steam instead of closed one and regulated in such a way that pressure inside the vessel should remain at 4 mm mercury and temperature 175°C. This condition is to remain for 4 hours after which heating is discontinued and oil is allowed to cool down to 90°C and processed oil is transferred to the second pressure vessel.

In the second stage the oil is heated under vacuum (27" mercury) at 95°C till it is ensured that oil is absolutely dry. Then bleaching earth is sucked (3% of the oil by weight) and the oil is bleached at 110°C at 27" mercury vacuum for 30 minutes. Thereafter oil is cooled upto 90°C and filtered through filter presses.

With above treatments not only that the unsaponifiable matter is completely removed but also there will be colour reduction of 80 to 90 per cent from raw oil. This processed oil will be fit for toilet soap. It is yet to be seen however whether it will be fit for edible purposes or not, probably if we process further as suggested by Dr. Kane, it may be used for edible purpose since both unsaponifiable matter and free fatty acid will be nullified. But at the same time economic factor to be taken into consideration.

Once we start using the processed Mahua oil in toilet soap we will be able to avoid using tallow which is being imported from

Australia and U S A, saving countries valuable foreign exchange. By fat splitting of this oil we will not only get valuable fatty acids like stearic, palmitic, oleic etc., but also glycerol which is a value added item, used directly as cosmetics for manufacture of explosives, manufacture of toiletries and medicines. Hence processing the oil although apparently may cause little losses (Process loss), but actually it makes the products much more acceptable and finally add to our gross national income. Above all by using Mahua oil we will be able to restrict use of edible oils like coconut oil or groundnut oil in soap, releasing them for edible proposes.

Mahua oil also has emollient properties and is used in skin diseases, rheumatism and headache. It is laxative, useful in piles and haemorrhoid, also used as an emetic.

After extracting oil from Kernal what remains is oil cake. Mahua cake contains 3.5 per cent Nitrogen, 0.52 per cent Phosphorus as P_2O_5 , 1.5 per cent Potassium as K_2O beside 20 per cent crude protein and 70 to 75 per cent carbohydrates. Besides it contains Saponins and some other toxic ingredients. Although it is used as manure due to presence of NPK and its wormicide value, proper use of Nitrogen is not utilised due to presence of toxic substances which inhibits rapid nitrification and prevents normal soil microbial degradation of proteins. It could have been a good protein food since it has 20 per cent protein. But presence of toxic material again makes it unsuitable even as cattle feed. As chemical processing of Mahua cake is prohibitively costly, cheaper alternatives are being explored. However along with Shikakai (*Acacia Concinna*), it is used as hair wash particularly in South India.

Micro biological processing of Mahua cake in conventional biogas digester was found to be most effective and promising method for processing Mahua cake. Mahua cake has 70 to 75 per cent Carbohydrates and 20 per cent protein so the C/N ratio is suitable for biogas generation. Laboratory experiment in an anaerobic fermenters shows that 1 kg of oven dry cake can yield 175 to 180 litres of methane. The composition of gas varied from 80.20 to 100.00 of methane is to Carbon-di-oxide. Thus this gas is richer in methane than gobar gas. The only difficulty experienced is that acidity developed during fermentation retarded the gas production. By using 5 per cent alkali in the

stages, optimum pH 6 to 8 can be restored and thus helps to maintain continuous gas production.

As against 3.5 per cent of nitrogen in crude cake, the slurry from fermenter showed 6.3 per cent. If the alkali used in the fermenter is in the form of anion, the nitrogen content in the slurry can be further enriched. Enriched slurry from digester can be dried for easy storage and transportation and can be used as fertilizer even perhaps as cattle feed since it will have higher nitrogen and protein content with perhaps no toxic matters.

Flowers normally appears between and of February to April in clusters at the end of the branches. Mahua flower is well known for its sweet aroma. If organised properly during the month of March and April beekeeping industry can grow and we will be getting Mahua honey with sweet aroma. The flowers can be steam distilled to yield essential oil. Above all the flowers also contains a lot of sugar and they are rich in calcium and vitamins. Hence spent flowers after steam distillation can be used not only as a cattle feed but also as human edibles if properly processed. Incidentally, the tribals from Mahua growing areas boil the milk with Mahua flowers and then drink after filtration. Milk is a good solvent for calcium, hence they get a drink rich in calcium and vitamins with sweet aroma. It is with thinking a milk based drink following same principle and then preserving the same in a chilling plant. We may even think of spray drying this milk to give us milk powder richer in calcium and vitamins. It is reported vinegar can be produced out of Mahua flower. By extracting the flowers with hot water, a good quality syrup is obtained, useful in jams and sweet mean and as a substitute for honey. The honey obtained from Mahua flower is reported to be used for eye diseases. Mahua flowers are regarded as cooling, tonic and demulcent; used in coughs, cold and bronchitis. They show antibacterial activity against *Eschcoli*

Mahua fruits are fleshy, green berry, yellowish or orange brown when ripe, normally 2.5 to 5 cms. long. Appears during different months depending on the region e.g. April to July in North India while August to September in South. They contain one to four shining seeds. The rind is very popular among the tribals as eatable. They eat the nut raw or as vegetable after cooking. They also ferment the rind in their own way to

manufacture country liquor. If organised we will be able to get essential oil on distillation (Yield 0.03%). The reined also contain over 22 per cent ethyle cynamite which is useful for many purpose. It can also be used for alcoholic fermentation. Yield of absolute alcohol is reported to be 67.9 per cent.

After the tree stops giving fruits its wood can be used as timber. Since the wood is cellulosic it is worth thinking of manufacturing regenerated cellulose or viscose rayon after digesting and converting into pulp cellulose xanthate and so on.

The bark is used for rheumatism, ulcers, itches, bleeding and spongy gums, tonsillitis and diabetes mellitus. It is given to horses for stomachache. The bark contains 17 per cent tannin. If tannin can be extracted it will be useful for tanning as well as for dying. The roots are applied effectively to ulcers. Latex from bark resembles guttaparcha after coagulation. If processed properly latex can be converted into resin which may replace many of our synthetic resin.

With all the above we may conclude that economy of Mahua growing areas can change miraculously if the gifts from Mahua can be utilised properly. It can give oil for soap, medicines, tannins, honey, enriched milk and above all energy to run all these activities. Will it be proper to replace this plant by a plant totally new to area with the plea for commercialisation? Is it not adequately commercial if utilisation is planned properly? What more, it shall preserve the environment if Mahua plantation is encouraged.

CHAPTER 2

KARANJA

Karanja is a medium sized tree growing upto 18 meters which grows very fast and is drought resisting and tolerant to salinity. Grows all over India as a avenue tree and naturally grows along river banks, near sea beach and tidal forests. It is also found in Australia, Fiji Seychelles and South Eastern Asia.

Known as *Pongamia Pinnata* Linn or *Pongamia Glabra* Vent in botanical nomenclature is commonly called Indian beach in English, Snigdhapatra or Ghrtpur in Sanskrit, Karanja in Hindi, Kanuga in Telugu, Konga or Koronjo in Oriya, Dalkaramcha in Bengali and Karchaw in Assamese

Flowers are small white with brown calyx. Season varies from April to September and differs from locality to locality. It is generally used as manure for pot culture but beekeeping industry can also be planned during flowering season. It is reported that the flowers contains Kaempferol and waxes, hence medicinal. It is commonly used as manure for pot culture. Leaves used as fodder and as green manure for paddy, sugar cane, areca and coffee. The wood is hard and the stem bark contains waxes. Roots contain four furoflavines, viz. Keranjin, pongapin, pinnatin and gamatin.

Fruits appear immediately after flowering and mature after 10 to 11 months i.e., season varies from February to May of the following year after flowering. Fruits are flat, elliptical, 7.5 cm long, no pulp; enclose 1 to 2 kidney shaped brownish red kernal. Shell constitute 4.5 per cent, and Kernal 95.5 per cent per fruit. Yield of Kernal per tree is 8 to 24 Kgs. The seeds contain pongapin hence medicinal. Kernal contain 30 to 40 per cent oil and is tough white, covered by reddish brittle thin cover and cotyledons. However the Kernal yields 24 to 27.5 per cent in expeller and 18 to 22 per cent in ghani.

Oil is used upto 25 per cent in soap. It is also used in greases and lubricants, leather tanning, application in skin diseases, in pharmaceuticals and as disinfectants, besides epoxy resins. Properties of Karanja oil and fatty acids it contains are given below :

Properties of oil

Colour	- dark brown
Odour	- repulsive
Refractive index at 40°C	- 1.4734 to 1.4790
Specific gravity at 30°C	- 0.925 to 0.940
Iodine value	80 to 96
Saponification Value	- 117 to 195
Unsataponifiable matter	- 0.9 to 4.2%

Fatty acids

Percentage

Palmitic	- 3.7 to 7.9
Stearic	- 2.4 to 8.9
Oleic	- 44.5 to 71.3
Linoleic	- 10.8 to 18.3
Erucic	- 1.1 to 3.5
Eicosenic	- 9.5 to 12.1
Arachidic	- 2.2 to 4.7
Behenic	- 4.2 to 5.3

Oil is acid, reddish brown and non drying, and a resinous substance makes it unpalatable. Its pungent odour makes it unfit for use in toilet soap. However, it can be deodourised under high vacuum and high temperature. The oil can also be refined various other ways. Crude oil is treated with sodium chloride and then with alcoholic caustic soda in 3 stages concentrations of 0.1 per cent. Alcohol percolation of seed prior to crushing is also suggested. Most effective refining however is cold extraction with alcohol and subsequent refining and bleaching. But with all the above refining or processing, the oil can be declared edible.

Seed also content 13.5 per cent mucilage, traces of essential oil

and complex amino acid named Glabrin ($C_{21}H_{42}O_{12}N_4$). The four furoflavouides identified in seed is also identified in oil. If the principles are isolated from oil, furoflavanoids can be used for enhancing pigmentation of affected skin, polyphenols can be used as intermediates in pharmaceutical and aromatic industries, while Karanjin and pongamol also have various uses. Infact Karanjin is insecticidal, bactericidal and toxic to fish. In unsaponifiable matter β -sitosterol is identified.

After extracting oil what remains is oil cake. Cake contains 5.1 per cent Nitrogen, 1.1 per cent Phosphorus (as P_2O_5) and 1.3 per cent Potassium (as K_2O), hence is a good manure for sugar cane, coffee, oranges and paddy. It has also the capacity to repel red ants due to lipid associates. The cake can also be used for extraction of amino acid and for insecticidal composition. The cake also contain 23 per cent Protein hence useful in adhesives. It is also useful as water proof binder.

At the moment we must prevent indiscriminate felling. Since it is a quick growing plant, if its wealth is exploited properly, we can get its value quickly. Infact in our afforestation programme and at last as avenue plantation we can utilise this plant both for enhancing the beauty as well as for exploiting its wealth while environment shall be taken care since the plant is naturalized in the region for centuries. What I say there is no reason to discard this as non-commercial plant anymore.

CHAPTER 3

AMLA

Amla is one of the most popular home medicine and edible fruit in India. It was often prescribed by local vaidys for various diseases, but with advancement of allopathy, the use of herbal medicines started taking back seat and amla is no exception. However it is still considered as one of the important minor forest produce but growth of amla plant continued to be wild. Fact that most of the amlas were used in vegetable tanning process, there is still a doubt that how long our forest departments shall continue to encourage amla even as a minor forest produce since vegetable tanning is being discouraged in favour of chemical tanning. Considering amla as a plantation or afforestation plant however does not arise.

In botanical language amla is known as *Embolica officinalis*, grows almost all over India as a wild plant particularly in and near forest areas. Most of our tribals consider it as edible and the fruit is considered medicinal by almost every Indian. Infact every part of this plant is considered medicinal even by our modern scholars.

The seed itself contain 16 per cent oil which is not only medicinal but is fit as a raw material for soap. The properties of oil and the fatty acid it contains is given below which gives the idea of its value.

Properties of Amla Seed Oil

Refractive index at 31°C	1.4758
Specific gravity at 31°C	0.9220
Acid value	12.7
Saponification value	185

Iodine values (Wijis)	- 139.5
Acetyl value	- 2.03
Unsaponifiable matter	- 3.81%
<i>Fatty acid</i>	<i>Percentage</i>
Linolenic	8.78
Linoleic	44.0
Oleic	28.40
Stearic	2.15
Palmitic	2.99
Myristic	0.95

The oil can be utilised as medicines, cosmetics and besides of course for manufacture of soap.

However maximum medicinal value remains with the hard pulp of the fruit. Fruit contains phyllemblic acid (6.3%), lipides (6%), gallic acid (5%) and embolicol. Chromatographic study of the extraction of dried fruit shows tannins and colloidal complexes. Investigation by paper chromatographic method shows presence of Ascorbic acids. Crystalline vitamin C could be isolated from the fruit pericarp, in the laboratory in a yield of 70 to 72 per cent of the total. Isolation of mimic acid from the pericarp. Phyllembin, from Fruit pulp identified as ethyl gallate. It potentiates pharmacologic action of adrenalin in vitro and in vivo. Has mild depressant action on central nervous system and spasmolytic action. Leucodelphinidin is one of the main constituent of the bark, which has various aromatic and pharmaceutical utility.

It is therefore needless now to say the utility of this plant in various sector which is not encouraged for plantation even as a part of afforestation programme. Fact that this plant naturally growing in various part of our country for a number of centuries, soil condition and other aspects are obviously available for its growth. If systematically grown and appropriately utilised this plant can give us raw material for soap, raw material for pharmaceutical industry, as a nutrition

giving food, as an important tannin for vegetable tanning industry besides as a source of vitamin 'C' and ascorbic acid. Presence of gallic acids and gallites can be help us to manufacture dye for textile industry. Therefore till today it is non-commercial since we treated it as so, but amla, besides helping appropriate environment I can also help us in our economic revolution as described above if utilised appropriately and if planted systematically.

CHAPTER 4

KUCHILA

One of the most important medicinal plant available around us is Kuchila which is commonly used in some form or other in ayurveda, allopathy, homeopathy or even by the tribal of the area where it naturally grows. In botanical language it is known as *Strychnos nux-vomica* Linn., belonging to Loganiaceae botanical family. It is commonly known as Kuchila in Bengali and Hindi, Vishamurtri in Sanskrit and Snake wood in English. It grows mostly on hilly slope upto 4000 ft altitude and are commonly found in Orissa, Karnataka, Uttar Pradesh, Tamil Nadu, Maharashtra, West Bengal, Nepal, Sikkim and North Eastern India.

The tree is an evergreen handsome tree which gives fruit which when ripe becomes a pulpy orange coloured fruit as big as an apple. The pulp is bitter in taste and gelatinous. The seeds are flat and round. Every part of this plant is medicinal and cures a number of fatal diseases but over doses may act as poison. The leaves of the tree are applied as poultice to sloughing the wounds or ulcers when maggots are formed. The wood is said to be a popular medicine for dyspepsia while juice of fresh bark is given in doses of few drops to control cholera and dysentery. The bark is also employed in infusion or weak decoction as a tonic or febrifuge. The root is very bitter and is used to cure intermittent fever and the bites of venomous reptiles. The root bark ground into a paste with lime juice and made into pills are very effective against cholera. The paste made by rubbing the seeds is useful for rat bites. The paste of Kuchile seeds mixed with dry ginger and horn of antelope rubbed on a stone is used with benefit in muscular and chronic rheumatism. The oil obtained by heating the fresh seeds is also used for external application to chronic rheumatism also in palsy and relaxation of the muscles. Kuchila

is useful in the treatment of tobacco amaurosis and paralysis and as resiprocatory stimulant, it is used in emphysema, bronchitis etc.

Kuchila contains two alkaloids having important properties in following proportions.

<i>Alkaloid</i>	<i>Percentage</i>
Strychnine	0.5 to 1.2
Brucine	0.12 to 1.0

The alkaloids are mixed with strychnic or igasuric acid as igasurates and glucosides named Loganine, is present both in pulp of the fruit and the seeds, both of which contains strychnine. Kuchila also contains about 6 per cent Sugar and mucilage. The bark and wood contain brucine and leaves contain 0.2 per cent brucine but no strychnine.

Brucine can cure many important diseases like epilepsy and is useful for breathing troubles. Strychnine is an effective stomachic, tonic and stimulant, of course in a very minute doses. It increases secretion of gastric juices, sharpens appetite and promotes digestion. It helps peristaltic movement of the intestine. It is also used in the treatment of nervous disorders. It increases mental alertness, field of vision and capacity for muscular work. It is very effective in the treatment of paralysis. Various spasmodic diseases like cholera, asthma and epilepsy are said to be cured by Strychnine. It is also employed hypodermically as a remedy in narcotic poisoning and against the effects of chronic alcoholism and also as an antidote to snake bite, administered hypodermically close to the bitten part. The alkaloids can be extracted easily by using turpentine as solvent. However, Kuchila extracts available in the market often being adulterated with extracts of two other plants of same family, viz. *Strychnos nux-blanda* and *Strychnos potatorum*, since availability of Kuchila is gradually diminishing due to the reasons already discussed. Therefore there is a need to reverse the trend.

CHAPTER 5

NAGKESHAR

Nagkeshar is one of the popular medicinal plant whose various parts are used for various purposes in our Ayurvedic preparations since several centuries, yet is considered as a non-commercial plant. Due to its diminishing trend, it is reported that few of the organisations started planting this plant close to their factories solely for the purpose of manufacturing herbal medicines but mass scale plantations was never thought of. Known as *Mesua ferrea* Linn, in botanical family. It is also known as Nahor in Assamese, Nagchampa in Gujrathi and Marathi, Nageshwara in Oriya, Nagal in Tamil and Nagkeshar in Bengali, Sanskrit and Hindi. In English it is called Pagoda tree or iron wood tree. It grows in many parts of India like Eastern Himalayas, Western ghats, South Kenara to Kerala, West Bengal, Andamans, Orissa, Assam and North Eastern India.

Nagkeshar trees are large, handsome, evergreen with conical crown and are shade loving. The young shoots changes its colour from red (Sometimes yellowish white) to pink or olive and finally to dark green. The height of the tree varies between 12 ft. to 50 ft (3.5 mts to 15 mts). The tree matures in 15 to 29 years for plantation in forest or plant respectively.

Nagkeshar wood is used as hard timber and definitely a useful raw material in a carpentary workshop. Oleoresin of bark is useful for varnish while bark root is used a infusion and tonic by local village doctors.

Nagkeshar flowers are 7.5 to 10 cm diameter and are white sweet scented. Flowering season varies from place to place normally 2 to 3 months before fruiting season. Flowers borne single or in pairs at the end of the branches. The flowers contain

sufficient essential oil which can be extracted by steam distillation. The flowers are also used as medicine as astringent and as expectorant. The dried stamens of flowers are also sold as Nagkeshar in the market as raw material for ayurvedic preparations.

Fruiting season varies from region to region. In West Bengal it is mid July to September in Assam and North Eastern region it is August to October in Karnataka it is May to July and so on. The fruits are about 7.5 cms in diameter and are reddish, conical, hard and oval. Each fruit weighs about 50 to 60 gms. Each fruit contains about 2 to 3 seeds. The seeds are also conical and shining brown. Each fruit has 50 per cent fibrous outer cover, 13.4 per cent brittle shell and 36.6 per cent Kernel. The Kernel is 70 to 73 per cent of the seed, round and yellow. Oil content in Kernel is 40 to 80 per cent.

The seeds are in order to extract oil, to be dried to 27 to 45 per cent. They are then to be decorticated by a small decorticator. In order to avoid pest attack the decorticated seed to be stored after spraying Aldrex powder (1% of the seed). The oil to be extracted first by expeller and finally by solvent extraction. Yield of oil is about 40 per cent.

The oil can be used upto 10 per cent for manufacture of semihard soap. The oil can be bleached easily by Chlorate bleaching that is by chlorine dioxide. The oil is semidrying in nature hence can be used for manufacture of paints and varnishes as alkyl resins. It is also used for storing enamel paints. Nagkeshar oil is believed to be an effective medicine for skin diseases and rheumatism. The oil however can not be used as edible oil since it is toxic in nature. The property and fatty acid content of Nagkeshar oil is given below :

Properties of Nagkeshar Oil

Colour	Dark brown
Odour	Slightly pungent
Consistency	Slightly Viscous
Specific gravity at 27°C	0.9598

Refractive index at 27°C	- 1.4780
Iodine Value	- 73 to 93
Saponification value	- 193 to 209
Unsaponifiable matter	- 2.9%

<i>Fatty acid</i>	<i>Percentage</i>
Myristic	0 to 2.8
Palmitic	8.0 to 13.6
Stearic	10.0 to 15.8
Arachidic	0 to 1.8
Oleic	55 to 66
Linoleic	10 to 20.

The oil also contains bitter yellow pigment called Mesuol upto the extent of 1 per cent. The oil also contains a phenolic substance Mesuone ($C_{20}H_{42}O_4$) which is antibacterial.

After extracting oil from seed or Kernal what remains is cake. Nagkeshar oil cake however can not be used as cattle feed since it is toxic in nature. However it contains a number of amino acids which if isolated can be used for various useful purposes. It contains 5.1 per cent Nitrogen and in good proportion of Phosphorus hence can be used as a good manure. By using an alkali with it to limit the pH upto 6 there is possibility of producing biogas which will be a useful source of energy while the nitrogen and phosphorus content can be further enriched. Protein hydrolysates can be isolated from the cake.

Besides what described above there are many other utilities which are yet to be exploited. The hard pericarp of the fruit contains tannin hence can be used for vegetable tannin if extracted. The shell contains Pentosan hence can be utilised for the manufacture of furfural. Incidentally furfural is a useful chemical used in leather industry, pharmaceutical industry etc., and there is insufficient supply from Indian manufacturers considering the demand. The fibrous shell can be utilised for manufacture of paper adhesives.

The story of Nagkeshar should not end here, but should continue progressively with more plantation to bring back environmental balance and appropriate utilisation for economic prosperity.

CHAPTER 6

CHAMPA

Champa, known as *Michelia Champaca* Linn., in botanical nomenclature grows almost all over India both in low and high altitude places. However, it was never considered as a plant to be cultivated since it is normally not considered commercial. At the same time it is common to see the Champa plant as avenue plantation or as a plant grown in a court yard mainly due to its sweet smelling flowers. In some cases, it is felled since there is a belief that it invites snake due to sweet aroma.

The plant grows upto 4 mts having leaves of 30 cms long and 10 cms wide. Although evergreen, it is not thickly populated with leaves. The flowers are slightly off white in colour with specs of red or brown and known for its sweet aroma, due to presence of essential oil. Flowers yield essential oil upto 0.064 to 0.068 per cent. Honey from the flower is also very popular and there is possibility of growth of beekeeping industry.

After flowering comes green round shaped fruit. Fruit rind also gives essential oil if extracted by steam distillation. Each fruit contains one or two seeds. The seed yield about 32.2 per cent oil. The property and fatty acid content of Champa seed oil is given below :

Properties of Champa Seed Oil

Specific gravity at 18°C	- 0.903
Melting point	- 44 to 45°C
Saponification value	- 196 to 199
Iodine value	- 60.3
Acid value	- 52.6

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	30
Oleic	70

The oil can be used in soap at a low percentage but at higher proportion in soft soap. But extraction of fatty acid shall be more effective since number of fatty acid it contains is less. Both the fatty acid it contain are having a number of uses like in pharmaceutical, cosmetics, soap making and so on. Oleic has use in mineral dressing industry too as frothing agent. It is also reported that the plant contains a number of alkaloids.

Oil cake however can not be used as cattle feed due to presence of lipids. But since NPK contain is pretty high and protein it contain is high, it can be used as a manure. Due to presence of protein it can also be used in adhesive industry.

There is need however to study more on Champa plant to know more about its utilities. However, feeling of Champa should be avoided as it should continue to add beauty and fragrance to our environment.

CHAPTER 7

SAPOTA

Sapota fruit is a popular fruit all over India. It is also known as Chiku in Marathi and Gujrathi. It is a natural plant all over India but cultivated commercially in Maharashtra particularly at Dahanu between Bombay and Surat. However it also grows as avenue plant and as a part of total horticulture all over India.

Botanically known as *Achras Zapota* Linn., belongs to Sapotaceac, is a medium sized evergreen tree growing upto 10 ft. Almost round the year the trees are found fully covered with leaves. The fruits are round shaped with a diameter of about 5 cms and brown coloured. The skin is thin and pulp is in the form of semi circular section with black semi elliptical seeds in between. Inside seed is the Kernal.

The Kernal contains 20 per cent oil which can be crushed either by expellar or Ghani having negligible lipids hence may be thought as edible oil. However it can definitely be used as raw material for soap. Properties of Sapota oil is given below :

Properties

Specific gravity at 31°C	- 0.8725
Refractive index at 31°C	- 1.462
Saponification value	- 205.4
Iodine value	- 59.8

Fatty acid content of Sapota oil is given below.

<i>Fatty acid</i>	<i>Per cent</i>
Lauric	1.6
Myristic	6.2
Palmitic	12.6

Stearic	12.0
Oleic	66.2
Linoleic	1.4

If the oil can be cracked, we can get individual fatty acids after fractionation besides glycerine. These fatty acids can be used as raw materials in soap industry, chemical industry, pharmaceutical industry besides mineral dressing. Glycerine can be used directly as cosmetics or as raw material in explosives and cosmetic industries.

The fruit pulp reported to contain glucose and sucrose hence is an important source of calories. It can be used in fruit preservation industry. It is believed to be a good stimulant, appetiser and mild laxative. The fruit skin contains essential oil and alkaloids. Bark possesses a water soluble tuberculostatic principle.

Exploiting fruit as a food item as begin done now is part of the total story. There is further scope for research and industrial utilisation for various purposes which shall enhance the total value.

CHAPTER 8

CHAULMOOGRA

The tall deciduous, evergreen tree with profuse branching growing upto 12 to 15 metres high seen in all over India in various varieties of same family is the Chaulmoogra or Dalmugri, believed to be one of the most popular medicinal tree in India. There are three varieties of Chaulmoogra grows in various parts of India, utilised traditionally more or less in an identical way.

The first variety botanically known as *Hydnocarpus Curzil*, known as Chaulmoogra or Dalmugri in Bengali, Dieng-sonlap in Khasi, Rowaithing in Mizo and Lamtem in Assamese, are found commonly in West Bengal, Bangladesh and North Eastern states. The second and third variety botanically known as *Hydnocarpus laurifolia* and *Hydnocarpus Wightiana* grows mostly in tropical forests of Western ghats, along the coast of Maharashtra and Kerala and occasionally found all over India. It is known as Garadphal in Sanskrit and Hindi, Kavathi in Marathi and Gujrathi, Marati in Malayalam, Niradu in Tamil and Chaulmoogra in Bengali. The fourth variety botanical known as *Hydnocarpus alpina* also known in similar names in various languages. All these plants belong to Flacourtiaceae botanical family.

Chaulmoogra flowers appear during the months of January to April are white in colour and appears either solitary or in racemes. Since it has nectars there is good scope of growth of beekeeping industry and Chaulmoogra honey can be used various purposes as in case of honey from other floras.

Fruit usually appears during the month of August to September, but varies slightly from region to region. The fruits are generally 10 cm in diameter, globose or ovoid having thick woody rind. Pulp in the fruit is usually 50 to 55 per cent. However the pulp and husk of the fruits need further research.

Fruit traditionally used for fish poisoning. Yield per tree is about 100 kgs of fruit.

About 20 per cent of the fruit is the seed. Each fruit contains 10 to 16 black conical seeds embedded in pulp. About 60 to 70 per cent of the seed is the Kernal. Kernal contains 63 per cent oil can be extracted by expeller or Ghani after decortication. The property of Chaulmoogra oil is given below :

Properties of Chaulmoogra oil

Colour	- Pale yellow
Consistency	- Liquid
Specific gravity at 25° C	- 0.940 to 0.960
Melting point	- 22 to 23°C
Refractive index at 40° C	- 1.472 to 1.476
Iodine value	- 92 to 103
Saponification value	- 198 to 204

The oil contains various fatty acids in following proportions

<i>Fatty acid</i>	<i>Percentage</i>
Hydnocarpic	48.7
Chalmogric	27.0
Garlic	12.2
Oleic	6.5
Palmitic	1.8
Unidentified	3.4

The oil is used upto 15 per cent in medicated soap. The oil contains lipids such as Ethyl hydnocarpate and also sodium salts of fatty acids for effective treatment of leprosy and tuberculosis as intermuscular injections. A number of preparations of ethylesters such as Moogrol, Antilepol, and Chaulestrol are available. The oil possesses marked therapeutic value especially in the treatment of leprosy. In culture media, various hydnocarpaceae have checked the growth of acid fast *Mycobacterium laprae*. The oil is active against acid fast

bacteria. Sodium salts of Chalmoogetic and hydnocarpic acid in 1 : 1,00,000 dilution are reported to be bactericidal against *M. tuberculosis*.

The Chaulmoogra cake has NPK value of 6.88 per cent, 0.93 per cent and 1.28 respectively as N_2O , P_2O_5 and K_2O , hence is considered as a good manure. It is also deterrent against ants and other insects. It is applied to tender leaves and terminal bud of coconut tree against Rhinoceros beetle. Since the cakes also contain same lipids as that of oil, they can be isolated for pharmaceutical used.

Chaulmoogra, therefore is not just a wild plant but something beyond, if of course utilised properly.

CHAPTER 9

SAL

Till recently Sal tree was famous for providing us substandard timber. After teak and mahogany timber became dearer, the Sal timber was elevated to the position of superior timber and as it stands today Sal timber has also become dearer and are used only for manufacturing specific items only.

Known as *Shorea robusta* Gaertn., in botanical nomenclature and belonging to the botanical family of Dipterocarpaceae, is a large, sub-deciduous tree of the height 18 to 30 metres. It is commonly found in the forests of North-East, Central India covering Orissa, Madhya Pradesh, West Bengal besides continuous stretch from Ambala District along sub-Himalayan tract and Himalayas upto Darrong and Tripura. Grow both in dry and moist forests.

The leaves of Sal tree is large in size and hence do have a lot of utility. It is a good leaf for green manuri. The Sal leaves are good feed both for Tussar as well as for Muga silk worm. Hence it is utilised for cultivation of Tussar in Central India and Muga for North East. It is commonly used for manufacture of bidi as outer shell like Kendu leaf and used as platters and bowls. This industry has recently become very popular under rural development schemes and because of market demand of leaf cup and plates. As regards timber it is well known and told in first para. Wood resin of Sal is extremely popular as disinfectant and fumigant. It is also used in incense and also for manufacture of points and varnishes besides phenyle.

Sal flowers usually appears in the month of May-June. They appear in auxiliary or terminal panicles, yellowish, small and profuse. Since it has got nectars, it is suitable for beekeeping industry. It is reported that Sal honey has more of Luvlose and less of Sucrose hence suitable even for mild diabetes.

Sal fruits appear in the month of July-August. Fruits are five wing like sapels and one seed. There are three category of sizes of the fruit such as 16.5 x 12.8 cms, 4.5 x 10.3 cms and 9.75 x 6.8 cms. The fruit contains 20.8 per cent wings, 12.8 per cent shell and 66.4 per cent Kernal. The fruit is occasionally used as vegetables for cooking by some local people and also as cattle feed.

Kernal are available in the seed in 2 to 4 segments. Oil content in Kernal is 14 to 20 per cent and moisture 4.7 to 20.8 per cent. Free fatty acid is oil increases very fast during strage of the Kernals. Hence there is need to extract oil as soon as possible after decortication. However in case it has to be storage, to protect from infestation of insects, it has to be treated by aluminium phosphide. After collection of fruits it should not be allowed to germinate in wet ground. Fruits are allowed to fall on the ground, forming a laver and are swept together and hand picked.

Fat traditionally obtained by water-rendering, crushing on expeller and direct solvent extraction are found to be not efficient. Maximum recovery is obtained by solvent extraction of cooked and fladed Kernal, keeping the residual oil in cake to 0.7 per cent. Food grade Hexane is used for solvent extraction. Yield of refined fat to fat is about 81 per cent. The properties of Sal fat is given below :

Properties of Sal Fat

Colour	- Yellowish green
Consistency	- Hard and brittle
Melting point	- 35.2°C
Specific gravity at 30°C	- 0.8692
Refractive index at 40°C	- 1.4579
Saponification Value	- 190
Iodine Value	- 37.9
Acid Value	- 10.6
Unsaponifiable matter	- 0.91%

Fatty acid content of Sal fat is given below.

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	- 4.5 to 8.6
Stearic	- 34.2 to 44.2
Arachidic	- 6.3 to 12.2
Oleic	- 41.4 to 42.2
Linoleic	- 2.7

Sal fat is locally used as edible. Used for soap upto 30 per cent but dark colour comes on the way for use in fancy soap. Can be effectively bleached by Chlorate bleaching with the help of Chlorine dioxide which can be produced by the reaction of Sodium Chlorate with dilute Sulphuric acid. Peroxide bleaching is also effective but the colour comes back after some time. Refined modified fat substitutes cocoa butter in confectionary industry to a great extent. This development has enhanced the demand for Sal fat and Sal fat as it stands today is one of the most important exportable item particularly to Japan. By fat cracking it can be good source of fatty acids particularly Stearic, Which is an important raw material for shaving cream and shaving cups and oleic used in mineral dressing industry and pharmaceuticals.

After extracting fat what remains is oil cake. Oil cake certainly be used as a good manure as in case of any other oil due to identical NPK Value. The cake contains 50 per cent starch, 10 to 12 per cent Protein, 13 per cent tannins, 5 to 6 per cent minerals and sufficient essential amino acids. Since with all these values it does not contain any toxic material it is ideal for cattle and poultry feed. Decoloured meal upto 5 per cent in compound feeds and tannin free cake upto 30 per cent is ideal. It is also ideal as an extender for urea formaldehyde resin adhesive for plywood industry. Starch and tannin in the cake can be effectively utilised for industrial sector like tanning of leather, food and pharmaceuticals, etc.

Sal tree is known by various names in various names in India. It is known as Ashwaskarna in Sanskrit. Sal in Hindi, Shal in

Bengali, Taksal or Kung in Lepcha, Diengblei in Khasi, Salwa in Oriya, Kabba in Kannada, Tamba in Telugu, Kungiliyam in Tamil and Maramaram in Malayalam. While it gives environmental stability, it also gives valuable ingredients to our industry and home hence can not be discarded as non-commercial. Let us help its growth for our growth.

CHAPTER 10

SARPAGANDHA

Sarpagandha, known in botanical nomenclature as *Rauwolfia Serpentina* Benth are found practically all over the country especially in Himalayan terrain, Bihar and West Bengal upto an altitude of 1200 mtrs. It has mostly wild growth and is basically a victim of afforestation as described before. Cultivation was attempted in U.P. Rajasthan, Gujrat and Maharashtra with limited success. Belonging to botanical family of Apocynaceae is a small shrub and is very fast growing.

A popular medicinal herb both according to Ayurvedic system as well as according to herbal system of various tribes and was used for centuries in raw form as well as part of prepared medicine.

Traditionally Sarpagandha root was commonly used for our herbal preparations. It was used as hypnotic, sedative. Decoction of root was employed in labour to increase uterine contraction. The root is also used in psychoses, neuropsychiatric disorders, schizophrenia and epilepsy, high blood pressure besides painful affections of bowels.

Total alkaloid from root is 2 to 3 per cent, root bark upto 4.13 per cent while stem and leaves about 0.5 per cent. Roots from West Bengal yield 6.6 per cent, M.P. 27.2 per cent and that from UP, Assam, Bihar, Kerala and Orissa about 13.3 to 18.9 per cent. On the other hand oleoresin fraction containing reserpine is 12 to 16 of the total alcoholic extraction. Therapeutical preparations from Sarpagandha are variously based on total root powder, root bark, total extraction, total alkaloids, pure alkaloids alone or in admixture with other drugs.

Reserpine isolated from the resinous fraction of Sarpagandha is a weakly basic indoline alkaloid with a Carboxylic ring E. Out of all the alkaloids present in Sarpagandha, it is the most

important therapeutic principle. It is infact commercially produced from Sarpagandha. About 20 alkaloids have been isolated from Sarpagandha, other important alkaloids besides reserpine are reserpinine, ajmiline, Sarpajmaline, ajmalicine and Serpentine. Reserpine is a central depressant, sedative, hypotensive with bradycardia. Its effect in doses in adjusted to individuals (0.05 to 2.0 mg daily), is slow on onset, becomes cumulative and continues for some time after withdrawl. Pavental therapy is resorted to when oral administration is impracticable. Reserpine is most valuable in younger patients with mild labile hypertension associated with tachycardia. In older cases it is used with more potent hypotensives. It is used as sedative in mild anxiety states and chronic psychosis. In severe muscular injection it should be given with caution in anxiety depressive states, cardiac arrhythmia, myocardiac infarction, bronchitis or gastric ulcer. It has a relatively low toxicity commonly producing nasal congestion, peculiar dreams, Vertigo, gastrointestinal upsets which are usually transient. Reserpine is not habit forming.

Reserpinine has hypotensive sedative bradycardiac activity similar to that of reserpine.

Ajmalicine is a central depressant and adrenergic blocking agent.

Ajmaline, an indoline alkaloid of medium basicity may be used in hypertension complicated by a cardiac condition in combination with other hypotensive agents.

Deserpidine which differs from reserpine by the absence of a methoxyl group in ring A. In female it suppresses vaginal Keratinization, induces permanent estrus and stimulates mammary glands. In male it dissociates the germinal and endocrine functions of testicles.

Serpentine is the major yellow anhydronium base of Sarpagandha. It is twice as hypotensive as ajmaline and shows synergistic activity when administered with reserpine.

This wonderful herb is gradually vanishing both due to deforestation and afforestation. It is time to think for cultivating it or considering it as a part of afforestation programme. The reason need not be elaborated after what has been described above.

CHAPTER 11

SULTAN CHAMPA

A evergreen, submaritime tree commonly growing wild in coastal India and Andamans is Sultan Champa which is also known as Punnag in Sanskrit, Punnai in Tamil, Undi in Marathi, Poonag in Oriya and Alexandrian, Laural in English. It belong to Guttiferae botanical family and called *Calophyllum inophyllum* Lam., in botanical nomenclature. The tree grows upto 40 ft and matures after 10 years with life span of 100 years. Wood of this tree is used extensively for boats and sleepers. The entire plant considered to be medicinal.

Sultan Champa flower usually appears during the month of March and April although in South India it appears a little later. In some places it appears in winter too as a second crop. The flowers are white sweet scented and appears in bunches. It contains sufficient essential oil for extraction commercially. The flower is also considered medicinal by local doctors of place of occurrence.

Sultan Champa fruits usually appear during July, August but extends even upto December. Unripe fruit is green and round with about 2.5 cm diameter. Ripe fruit on ripening becomes yellow. It appears usually in two sizes depending on the place of occurrences. The bigger weighs 16.6 gm and the smaller 9 gm when fresh and 8 gm and 4 gm respectively when dried.

About 43 to 52 per cent of the dry fruit is the Kernal. The Kernal is big round and 1.5 cm in diameter and found enclosed in a soft seed coat, and a hard seed coat. The seed coat hard testa contains leucocyanidin which can be used as a basic raw material for various pharmaceutical preparations.

Kernal contains about 55 to 73 per cent oil and 25 per cent moisture. Fruits are fallen or felled by hand and hand picked. The fruits are then dried and Kernals are separated. Kernals are

decorticated by mechanical means, chipped and further dried. Oil yield is 50 to 60 per cent in Ghani and 50 to 65 per cent in expeller.

The properties of Sultan Champa oil is given below.

Properties of Sultan Champa oil

Colour	- Greenish yellow
Odour	- Strong, pungent
Consistency	- Liquid
Refractive index at 15°C	- 1.4699 to 1.4772
Specific gravity at 15°C	- 0.9415 to 0.9452
Iodine value	- 82 to 98
Saponification value	- 191 to 202
Unsaponifiable matter	- 6.25 to 1.4%

Fatty acid content of Sultan Champa fat is

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	14.8 to 18.5
Stearic	6.1 to 19.2
Oleic	36.2 to 53.1
Linoleic	15.8 to 28.5
Erucic	3.3

By cracking the oil followed by distillation we can get individual fatty acids used for various industries. Oil can be used upto 25 per cent in soap. The oil is viscous, pungent and deposits stearin on standing. Contains 10 to 30 per cent resin used for varnish and medicines. Can not be used as edible due to presence of toxic matters. Used in medicinal oil since it is anti fungal. Used for coating boats to avoid fungus. Oil can be refined by alcoholic treatment. A two stage alkali refining using 15 to 20 per cent caustic soda solution in slight excess is also possible. Used in soap after graining process. Refined oil injected intramuscularly to relieve pain in leprosy. Oil turns black with prolonged contact with iron.

Unsaponifiable matter in oil contains Sistesrol. It also contains Calophyllolide which is bactericidal and anti coagulant. It also

contains Inophyllic acid which is fungicidal besides polyphenols classified as 4-phenyl coumarins, Calyphylic acid and Inophylloide. These lipids if isolated can be used effectively in pharmaceuticals.

Oil cake contains Nitrogen upto 3.79 per cent, Potassium (as K_2O) 1.49 per cent and Phosphorus (as P_2O_5) 1.49 per cent hence is a good manure. A good pesticide and fungicide because of presence of lipids but unfit as cattle feed.

The tree still grows wild and considered non-commercial except as avenue plantation. A victim of both deforestation and afforestation. There is a need to look into this aspect to ensure better sustainable development.

CHAPTER 12

TAMAL

Tamal is a evergreen medium sized tree commonly found in West Bengal, Bangladesh, Assam, Orissa, Bihar, plains of U.P. and South Indian states. It is also known as Gambog, Pinuarpuli, Irevalsinni and Pasupavarne in various Indian languages. In botanical nomenclature it is known as *Garcinia morella* Desr. belonging to Guttiferae botanical family. It is normally grown as avenue plant or garden plant due to its beautiful flower.

Most of the part of the plant is believed to be medicinal but presently used by local doctor as traditional herbal treatment. Its bark is believed to be helpful for breathing trouble and bronchitis. Flowers can be a good source of essential oil. Growth of beekeeping industry is possible since the flower has nectar.

Most useful part of Tamal is its seed. Seed Kernal contains 57.5 per cent oil which can be used for various purposes. The properties of oil is given below :

Properties of Tamal Oil

Melting point	- 29 to 37°C
Saponification value	- 19.1
Iodine value	- 48.3
Consistency	- liquid

Fatty acid content of Tamal oil is given below

<i>Fatty acid</i>	<i>Percentage</i>
Myristic	0.3
Palmitic	0.7 to 7.2
Stearic	42.5 to 46.4
Arachidic	0.3 to 2.5

Oleic	43.6 to 49.5
Linoleic	0.9 to 6.1

Unfortunately this high yielding oil seed is not yet utilised appropriately. However it is not yet assessed whether the oil is edible or not. For use as raw material for soap, it can only be used upto limited extent due to low saponification value but can not be totally discarded. But it contains many useful fatty acids notably Stearic and Oleic which can be extracted by fat cracking followed by distillation. Since use of these two fatty acids were discussed in details earlier it may not be repeated here.

Pericarp of the seed yields 20 per cent morellin which is highly active compound. It is used in preparation of number of drugs in pharmaceutical industry besides various chemical industries. Pure morellin can be extracted from seed coat husk. Various part of the plant yields colouring matters like isomorellin, desoxymorellin and dihydroisomorellin. These compounds if extracted can be used as basic dye for dye industry.

We have never given any serious thought on this plant so far. We must direct our R & D to know more on this plant so that it can become an useful plant for sustainable development.

CHAPTER 13

SUAK

A medium sized evergreen plant known as Suak in Punjab, Haryana and U.P. is a popular plant for its tasty edible fruit. It is known as Seabuckthorn or Sand-thorn in English and Chuma, Dhurchuk, Tarru and Milech in other Indian languages which grows well both in dry and moist soil mostly found in Hindi belt, West Bengal and Central India. It is called *Hippophae rhamnoides* Linn., in botanical nomenclature belonging to Elaeagnaceae botanical family.

The fruit is acidic and made into jelly with sugar. A syrup prepared from the fruit is given in lung complaints and a decoction for cutaneous eruptions. The fruit is a rich source of Vitamin C (ascorbic acid and dehydro ascorbic acid). Berries give 80 mg. Vitamin C in one cup of tea which is mostly destroyed on mins standing. Fairly stable food products have been prepared from the fruit. The juice powder keeps its vitamin potency for 2½ years. The mature fruit is rich in carotene and vitamin B₁. The fruit yields a dark red fatty oil (yield 2%) of pleasant odour and taste. The centrifuged oil is a concentrated source of carotene.

The bark contains a yellow fatty oil, two alkaloids and carotene. Hence it can be used for medicinal and industrial purposes. The twigs and leaves contain 4 to 5 per cent tannin. Therefore they can be effectively used for vegetable tanning industry. The leaves also contain carotene, ascorbic acid and dehydroascorbic acid and is a rich source of Vitamin C. Presence of hemnin is reported in root modulas.

The seeds contain a yellow slow drying oil, of about 12.13 per cent. The properties of Suak oil is given below :

Properties of Sauk Oil

Colour	- Yellow
Consistency	- Liquid
Specific Gravity	- 0.9278
Refractive index	- 1.4739
Saponification Value	- 193
Iodine vlaue	- 138
Unsaponifiable matter	- 1.78%

The fatty acids that the Suak oil contains are given below :

<i>Fatty acid</i>	<i>Percentage</i>
Palimitic	10.9
Stearic	
Oleic	41.5
Linoleic	14.3
Linolenic	12.6
Is - linolenic	20.7

Suak fat can be a good raw material for soap and may be tried as edible also. By cracking the oil and further distilling we can get individual fatty acids and Glycerol. Fatty acids besides being used as raw material for soap can also be used in mineral dressing, drugs and pharmaceutical besides various other Chemical industries. Glycerol can be used for manufacture of explosives and nitroglycerine, cosmetics and pharmaceutical industry. Glycerol with appropriate grade can directly be used as cosmetics for winter. The seeds also contain two pigments, Zeaxanthin and carotene. Therefore it can also be utilised for dye and pigment industries besides Chemical and pharmaceuticals.

This traditional plant therefore need to be cultivated and should be included in plantation programme for sustainable development since virtues that it has itself is the justification.

CHAPTER 14

INDRAYAN

Indrayan is a perennial creeper with a prostrate or climbing stems. Remains dormant in summer or in adverse circumstances and grows again in rainy season or in favourable conditions. It is known as Indrayan or Mahaphala in Sanskrit, Gurrub or Tumbi in Punjab and Haryana, Tumba in Rajasthan, Indian colocynthis or bitter gourd in English and Indrayan in Bengali. According to botanical nomenclature it is called *Citrullus Colocynthis* Schrad, belonging to Cucurbitaceae botanical family. Grows wild in warm sandy tracts of north West, Central and South India, Western sea shores notably Gujarat and Rajasthan besides West Bengal, Bihar, MP and UP. It also grows in other countries like Afganisthan Pakisthan, North Africa, Arab countries, Thailand, Japan, Spain and Portugal. All the parts of this creeper is medicinal.

The flowers are usually either yellow or white and has five petals. There is good scope for beekeeping industry during flowering seasons. Fruit appears during August and September. Spherical yellow fruit 3" to 4" in diameter, contains spongy pulp and numerous white and brownish compressed seeds embedded in the pulp. Dried fruit weighs 100 gms of which 15 gm pulp, 62 gm seed and 23 gm seed. A lone fruit appears at a time on a creeper. Bitter oil, citbittol can be isolated from peel free flesh of ripe fruit which is medicinal. Colocynth, the dried pulp of the fruit is used in indigeneous medicines. The extraction is highly effective against *Salmonella typhisa*, *Corynebacterium diptheria*, *E. Coli*, and so on.

The fruit juice contains α elatrine, Citrulluin, Citrullene, and Citrulluic acid. Fresh mesocarp of the fruit and seed contain Glucose and α pinosterol and crystalline bitters - P - Hydroxy benzyl methyl ester from the unripe fruit can also be extracted

which has various medicinal utility. Low boiling constituents of the fruit is also medicinal.

Seed contains 21 per cent fat and 12 per cent can be extracted in a expeller, mainly used for soap making as equivalent to semi hard oils like Mahua. The properties of Indrayan fat is given below.

Properties of Indrayan Fat

Colour	- Pale brownish yellow
Taste	- bitter
Saponification value	- 173.11
Iodine Value	- 117.8
FFA	- 1.40
Acid Value	- 3.97
Specific gravity at 28°C	- 0.9257
R.M.Value	- 0.351
Hehner Value	- 91.64
Unsaponifiable matter	- 2.4%

The fat contains fatty acids like Oleic, linoleic, myristic, Palmitic and stearic acid. The fatty acids can be isolated by fat cracking followed by distillation which can be used for various purposes. In this method we can get Glycerol as bye product which is also useful for various purposes described before the fat is also believed to be medicinal. After extracting oil what remains is oil cake. Oil cake can be used as manure besides for manufacture of adhesives.

In foreign countries dried pulp of the unripe fruit constitutes the colocynth which is used commercially for manufacture of medicines but in India it was never tried. Therefore studies in utilisation of pulp and cake require attention. This traditional plant with medicinal and industrial value need to be exploited properly for our sustainable growth.

CHAPTER 15

OPIUM

Opium is a well known drug since ages both in India and abroad. It grows wild as well as a cultivated crop, and is considered commercially valuable due to addiction. It is also considered important being source of important medicine. Opium plant is a small plant grown at selected places under Government control and known as *Papavar Somniferum* Linn., according to botanical nomenclature belonging to *Papaveraceae* botanical family. It is also known as *Khuskhus* in Hindi, and *Affing* in Bengali.

Opium plants are known for yielding morphine which is considered important as narcotic as well as basic medicine. Morphine yield in roots is 0.03 per cent in stems 0.05 per cent, in leaf 0.045 per cent and in capsules 0.11 per cent.

Indian opium consists of 10 per cent morphine, narcotine and meconic acid potential value 0.6 per cent and papavarine 0.1 per cent. Preparation and interconversion of poppy alkaloids, Kabay's method supplemented to separate codeine narcotine etc. Narcotins can also be isolated from poppy straw. Important secondary alkaloids present in the opium are Codeine, thebaine, papaverine and narcotine.

Opium capsules also contain codeine, narcotine and thebaine which can be isolated traditionally however it was used as narcotic without isolating the alkaloids.

Poppy seeds known as *Khuskhus* in Marathi and Hindi, *Posta* in Bengali is an important food item cooked with vegetables as well as with meat. The seed contains sufficient protein hence helpful for our growth. Seed contains 45 per cent fat which is used for manufacture of soap, varnishes and paints. Properties of poppy fat is given below.

Properties of Poppy or Opium Fat

Refractive index at 15°C	- 1.478
Specific gravity at 15°C	- 0.924 to 0.927
Saponification value	- 189 to 197
Iodine value	- 130 to 143
Titre	- 15 to 17°C
Acid value	- 1 to 10
Unsaponifiable matter	- 0.5 to 0.71

Fatty acid composition of opium fat is as under.

<i>Fatty acid</i>	<i>Per cent</i>
Palmitic	4.8
Stearic	2.9
Oleic	30.1
Linoleic	62.2

Beside the uses described above individual fatty acids and Glycerol can be extracted which has various uses.

Opium therefore can be utilised various useful purposes and should not be discarded just because it is the source of narcotic. Let us use this for better use effectively discontinuing its use as narcotic or drug.

CHAPTER 16

TEA

Tea perhaps is the most popular beverage of the world. The major producer of tea is India, China and Srilanka. In India it is commercially cultivated in Assam, West Bengal and Tamil Nadu. In West Bengal and Tamil Nadu the cultivation is limited to Darjeeling hills and Neelgiri hills respectively. While it is known as tea in English, it is called Cha in Bengali, Sha in Assamese, Chai in Hindi, Chah in Marathi and Cha in Oriya.

All the varieties of tea belong to *Camellia* genus and are known as *Camellia Sinensis* Linn., *Camallia Thea* Linn. and so on all belonging to Theaceae botanical family.

Tea is cultivated basically, because of the commercial vlaue of its leaves. While in one hand it forms habits and usually discouraged, on the other hand the tea infusion is an important source of flourine for our body. Tea leaves also contain Shikimic acid which is also necessary for our body. However most important being Caeffin which removes our fatigue. Caeffin is also an important ingradient for our pain killing drugs. Not only leaves, entire tea plant contains Caeffin which can be isolated in crystallised form, either from leaves or from stems.

Seeds produced by some of the species of *Camellia* are rich in oil. The oil content of tea seed varies from 15 to 45 per cent. In chemical composition, tea seed oil is very much similar to olive oil. Although tea seed oil makes a superior cooking oil, due to relatively high price, it is used mainly as a salad oil rather than for cooking.

One variety of tea, *Camellia Thea* Linn., has 22.9 per cent oil in its seed. The properties of Thea tea oil is given below.

Properties of Thea tea oil

Specific gravity at 15°C	- 0.921
Refractive index at 20°C	- 1.4707
Saponification value	194.2
Iodine value	- 93.2
Acid value	- 3.6
Unsaponifiable matter	- 1.5%

Fatty acids it contains are :

<i>Fatty acids</i>	<i>Percentage</i>
Palmitic	7.6
Stearic	0.8
Oleic	83.3
Linoleic	7.4
Myristic	0.3
Arachidic	0.6

It is no doubt one of the ideal cooking oil since it has more of unsaturated fat. It is also a good oil for manufacture of soap and good for massage. But use has to be limited due to its prohibitive cost.

Tea is no doubt one of the most important commercial cash crop of India. But its commercial value is limited to the marketing of its leaves while rest of its virtues are neglected. Sell of tea leaves and consumption as beverage is only a part of the story. Tea plant if exploited can give us much more than what it gives us today if utilised properly. Again what has been described above is also a part of the total story since more R & D on tea can perhaps give us much more than what we anticipate.

CHAPTER 17

KURCHEE

Kurchee is a evergreen medium sized tree found almost all over India but grows wild. Although it is known for its medicinal value. In English it is known as Conessi tree and called Kutaja, Kunda, Kodisepala and Kuda-sappalai various Indian languages. In botanical nomenclature it is called *Holarrhena antidysentrica* Linn, belonging to Apocynaceae botanical family. Except as a local medicine it is yet to be exploited properly inspite of its virtues.

The bark of Kurchee tree has astringent, antidysentric, anthelmintic, stomachic, febrifugal and tonic properties. It is used in the treatment of amoebic dysentery and diarrhoea. Although slow in action as compared to Ipecac (Emitine), it is less toxic. It is a substitute for emitine in amoebic dysentery.

Conessine, the principal alkaloid possesses antitubercular activity in situ. It increases coronary outflow in rabbit heart, induces narcosis in frog and produces local anaesthesia in guinea-pigs but causes narcosis on subcutaneous injections. All these aspects are still in experimental stage but perhaps we may get various utilities for human treatment also. About 43 per cent of Kurchee alkaloids are thermostable and 57 per cent are thermolabile. Seasonal variation of alkaloidal contents in the bark is also noticed. Isolation of alkaloids from bark therefore will give us much valued basic drugs.

Kurchee seed is basically a oil bearing seed. Its seed Kernal contains about 19 to 30 per cent oil. The physical and chemical properties of Kurchee oil is given below.

Properties of Kurchee oil

Specific gravity at 15°C	- 0.9354
Refractive index at 60°C	- 1.4666

Iodine value	- 149.1
Saponification value	- 180.5
Acid Value	- 36.1
Unsaponifiable matter	3.5%

Kurchee oil comprises of fatty acids as under

<i>Fatty acid</i>	<i>Percentage</i>
Linolenic	10
Linoleic	54.7
Oleic	21
Palmitic	5.6
Stearic	6.8
Lignoceric	1.9

Since saponification value is high it is suitable for soap making. But since unsaturated fatty acid is more and iodine value is high there has to be a limit to use this for soap making as it will have tendency to produce soft soap. Fatty acids if separated at oil stage shall give us individual fatty acids and Glycerol. Fatty acids can be used for soap making, chemical and pharmaceutical industries and so on. Glycerol has the utility as raw material for explosives industry and as cosmetic. The seed pericarp after the kernels are removed also contains alkaloids. However the oil is yet to be used as edible either in raw or processed.

Oil cake contains both NPK as well as protein hence can be used as manure or in adhesive industry. But its use as cattle feed yet to be tried. Kurchee leaves are considered suitable for green manuring. Kurchee flower contains nectar hence good for promotion of beekeeping industry.

Kurchee is one of the neglected vegetation and is a victim of both afforestation and deforestation. But if its virtues are considered, it needs special attention. Therefore as a part of our plan this plant has to be included in our plantation programme for sustainable development.

CHAPTER 18

MANGO

Mango is one of the most popular fruit in India. It is called Amra in Sanskrit, Aam in Bengali and Hindi, Mavu or Mango in Tamil and Malayalam, Keri in Gujrathi, Kairi or Amba in Marathi, Amba in Oriya and Maven gida in Kannada. In botanical nomenclature it is called *Mangifera indica* Linn., and belong to a botanical family Anacardiceae. About 210 varieties of mango is reported out of which Alfanso of Ratnagiri (Maharashtra) and Goa, Dasheri and Chowsha of U.P., Baiganpulli and Neelam of Andhra Pradesh and Karnataka, Langda of UP, Bihar and West Bengal, Himsagar, Fazlee, Golapkhush, Pyaraphuli of West Bengal are extremely popular. Out of all above Alfanso is most costly due to its export potentiality mainly due to it can be stored for longer period while langda is supposed to be most popular due to its taste and flavour. It also grows in far eastern countries, China, coast of tropical Africa, Florida and California and West Indies but the Indian mango can not be compared with them due to its superior taste and flavour.

The mango tree is large evergreen tree mainly valued for its fruit. It usually grows wild or semi wild throughout Indian tropical and subtropical hilly forests, particularly near ravines. Also grown in orchards, plantations and by road side.

Flowers at the end of winter and beginning of spring. It usually appears in bunches. It does not possess nectar, but promotes beekeeping since it gives honey dew. Flowers yield 0.04 per cent of an essential oil. Pannicles give ethyl gallate by alcoholic extraction. Dried flowers are astringent, given for diarrhoea, Chronic dysentery, Catarrh of the bladder and gleet.

Bark is astringent, used in diphtheria and rheumatism. It has

tonic action on the mucous membrane. An alkaloid called mangiferin has been isolated from the bark. Roots give the alkaloids mangiferin, friedelin besides of course β -sitosterol. Wood is considered moderately good timber.

Gum is used as a substitute for gum arabic, in dressing, for cracked feet and scabies. It is also considered anti syphilitic. The extracts of leaves, bark, stems and unripe fruits exhibit moderate anti-bacterial activity against *Microoccus pyrogenes*.

Fruits mature during April, May and June depending on region to region. Raw mango or unripe mango is commonly used for preparation of pickles and Chutney. It is also used as vegetable and with some of the preparation of pulses. It is considered coolant and believed to prevent sunstroke if consumed regularly during summer. Ripe mango is a popular edible fruit round the world. Antifungal microorganisms is reported in ripe mango. Ripe mango has also a coolant and supposed to prevent Sunstroke. Ripe mango pulp contains essential oil, vitamin C, minerals, glucose and Vitamins A, B₁ and B₁₂. Ripe mango pulp is also preserved by drying in sun and consumed round the year as dry fruit called Mango jelly in English, Amsattwa in Bengali and Ambasadha in Oriya. Ripe mango pulp is also diluted to be used as cold drink and as fruit salad. A ripe mango contains 15 per cent stone (seed) and 85 per cent skin and pulp. The skin also contains essential oil.

There is only one seed or stone in this pulpy fruit. It is usually thrown away after using the pulp. It consists of hard shell enclosing a Kernal. About 62 per cent of the seed is the Kernal. The Kernal is kidney shaped dicotyledons enclosed in a thin cover. It contains 11 per cent oil on moisture free basis. The Kernal of astringent taste, free from toxic principles and contains amino acids. Kernal powder is used as anthelmintic and in bleeding piles. Kernals after decortication of seeds turn black on storage, therefore there is need to immediately be passed through expeller followed by solvent extraction so that good quality fat can be obtained. The properties of mango fat is given below

Properties of mango fat

Nature

Semi solid, bland fat

Colour	-	Cream
Specific gravity at 30°C	-	0.9139
Acid value	-	0.28
Saponification value	-	194.8
Iodine Value	-	93.2
Hehner Value	-	95.7
Unsaponifiable matter	-	2.87

The mango fat contains fatty acids such as myristic, palmitic, stearic arachidic, oleic of 0.69 per cent, 8.83 per cent, 33.96 per cent, 6.74 per cent and 49.78 per cent respectively. This fat contains following glycerides as given below.

<i>Glycerides</i>	<i>Per cent</i>
Saturated Glycerides	14.2%
Mono-Oleoglycerides	24.2%
Di-Oleoglycerides	60.8%
Tri-Unsaturated Glycerides	0.8%

This fat can be used as edible either as cooking oil or in confectionary industry. It can be used as a substitute for tallow in soap industry. If fatty acids can be isolated we can get stearic acids used for shaving preparations, soaps and cosmetics, Oleic acid, used for soap making, mineral dressing industry besides chemical and pharmaceuticals. We can get Glycerol as by product either while cracking the fat or while manufacture of soap in soap lye. Glycerol of course have various uses. Oil cake has 6.25 per cent protein and sufficient NPK value. Hence it can be used as manure, cattle feed and for manufacture of adhesives.

Till recently only Mango fruit is being used as popular edible fruit but rest of the virtues are not being utilised. Even mango seed and Kernel having so much of virtues are being thrown away. The mangoes like Langda, Himsagar, Alfanso etc., having commercial appeal of their fruits are being cultivated but rest

having almost same virtue are being neglected. If India has to have stability economically, environmentally, industrially and many more, mango tree has definite positive role to play but we must grow it from its seed.

CHAPTER 19

TOMATO

Tomato is not basically an Indian plant although it is reported wild growth even earlier but traditionally not considered as useful plant. It was naturalised later and became an important cultivated vegetable all over the country. Plants are usually very small growing upto the height of half a metre. It is known by its English name tomato all over the country except few variations like Bilati Baigana in Oriya. Known as *Lycopersicon esculentum* Mill in botanical nomenclature belonging to Solanaceae botanical family.

Ripe tomatoes reported to contain iron in complex form hence useful for anaemia or other blood diseases. Ripe tomatoes also contain glucose and fructose with some scrose and a Keto heptose. Ripe and unripe fruits contain all the essential amino acids except tryptophan. The principal organic acid in tomato is citric acid. The acidity increases from the green to the turning stage and then decreases as the fruit ripens. The chief colouring matters are carotenoids, β -carotene, and lycopene. Maximum carotenoid, contents are obtained when the fruit is allowed to grow under full exposure to light and allowed to mature on the vine.

Tomatoes contain a gluco-alkaloid, tomatine and traces of Solanine. Unripe fruit reported to contain narcotine. Tomato seeds contain two globulins such as α -globulin to the extent of 13.97 per cent and β -Globulin upto 10.65 per cent. Isolation of tomatidine from the roots is reported.

Tomatine content in leaves reported to be 0.63 mg per 100 gms on an average. Leaves yield alkaloids tomatine and tomatidine, which are antifungal. Effects of inorganic N-nutrition upon the amino acids and amides in the leaves and roots is reported.

Today, tomato is being used as fruit when consumed uncooked. It is also consumed as part of vegetable salad as it adds to taste. It is also used as spices for preparation of both vegetarian and non-vegetarian dishes both due to its preservative and antifungal properties and well as for taste. Tomato chatney and pickles are popular side dish in India. Tomato pulp converted as cold drink is gaining commercial ground. Tomato ketchup and sauce are most popular side dish. But the other virtues of tomatoes are not being utilised. For example while manufacturing sauce or ketchup or packed pulp, seeds are filtered out and thrown. But this can be effectively be used for isolation of globulins. Similarly isolation of alkaloids from roots and leaves were never tried, nor they were used as food items. By isolation of alkaloids, they can effectively be used for manufacture of drugs and pharmaceuticals. Narcotic in a ripe fruit if can be isolated can be used as raw materials for various medicines.

There is need for further R & D on tomato plant, fruit, seed, root and leaves to know if we can get more. The R & D has to be with the help of applied science to finalising industrial methods of isolation or manufacture. Similarly utilisation of our own wild tomatoes were not tried which needs attention of elites of our scientific world.

CHAPTER 20

TOBACCO

Tobacco is one of the most widely cultivated crop of South India notably Guntur district of Andhra Pradesh. This small plant besides being cultivated also grows wild in the forest although the plant is a small one. There are sixty valid species of tobacco out of which only five varieties are cultivated in India used for various purposes. It is known as Tamaku, Dhuma patrika, Kshara patrika and Tamrakat in Sanskrit, Pogaku in Telugu, Tobacco in English, Tamak in Bengali, Tamaku or Tambaku in Hindi belt, Pughaiyilai in Tamil and Pukayila in Malayalam. In botanical nomenclature it is called by various name from species to species. Most widely cultivated tobacco is *Nicotiana tabacum* Linn. followed by *Nicotiana rustica* Linn. both belonging to Solanaceae botanical family. The wild variety found in India is called *Verbascum Thapses* Linn., belonging to Scrophulariaceae family.

Tobacco hails from Cuba and America. The use of tobacco by natives of Cuba was first observed in 1492 by the crew of Columbus who had gone to explore Cuba. During his another Voyage, Columbus saw the habit of snuff taking among the natives. In 1502, the spaniards saw the practice of tobacco-chewing on the South American coast.

The ancient natives of America worshipped tobacco as a gift from the great spirit. Tobacco was thrown into the sacrificial fires, during ceremonial occasions. The Indian tribe of North America, while gathering medicinal plant conduct ceremony by digging a small hole next to the plant and some tobacco is placed in it as offering to the spirit of the plant. Then the herb gatherer lights his pipe and smokes and prays to the spirit that govern vegetation. The knowledge and use of tobacco spread from America to Europe. The spaniards from America have

introduced its cultivation. In India, its use and cultivation date from arrival of Portuguese, in the beginning of 17th century. This was first cultivated in South India. But frequent reference of tobacco was found in ancient Indian texts which shows that tobacco was also a natural plant of India contradicting the theory above.

Nicotiana rustica requires a cooler climate for its growth as such mainly confined to the Northern and North Eastern part of this country. This varieties are short and have round puckered leaves and yellow flowers. This variety is grown only for hookah, chewing and snuff purposes but usually are not used in cigarettes, cigars or bidi. *Nicotiana tabacum* is grown all over the world. The height of this shrub is about half a metre and has many branches. The stem is hairy and tubular, and it has long and broad leaves. Fruits are oblong and seeds are small and reddish black in colour. Flowers are usually yellow as it starts blossoming and turns pink on ripening. Specific varieties for cigarettes cigars, cheroots, bidi, hookah, chewing and snuff have been developed in this species. Surat tobacco is specially grown around Surat of Gujrat and is used only for chewing purposes. Eastern tobacco spreads on all corners bending its leaves. The leaves are very broad and short in length. It is used for preparing Zarda etc. Forest tobacco or *verbascum thapsus* grows Himalayan or sub-Himalayan terrain. Leaves are very pointed and more yellowish than other varieties. It is used either with betel leaves or chewing with lime.

Tobacco is usually considered as habit forming plant and responsible for creating naughty boys. But it gives us many good ingredients too which if utilised can help us for our positive growth. The leaves of *verbascum thapsus* contains heteroside when fresh hence can help growth pharmaceutical. Apart from presence of nicotine in all varieties of tobacco leaves there are various other constituents. Nicotine itself either as nicotinic acid or as nicotine can be used for manufacture of certain basic drugs useful for certain acute stomach diseases and as pain killer. Biosynthesis of the nicotiana alkaloids is possible from the leaves of *Nicotiana rustica* leaves. Occurrence of l-quinic acid in leaves of the shade grown plants is reported. Chlorogenic and caffeic acids are also reported. Besides above terpenic constituents of tobacco is also useful.

After harvesting tobacco leaves, the seeds are collected from its capsules. Due to its hard pericarp, it consumes more electricity while crushing hence extraction of oil from tobacco seed is usually avoided in many countries. In India it is being used upto limited extent. The physical and chemical properties of tobacco seed oil is given below.

Properties of tobacco seed oil

Colour	- pale yellow
Consistency	- liquid
Specific gravity at 25°C	- 0.9232 to 0.9250
Refractive index at 25°C	- 1.4739 to 1.4828
Saponification value	- 186 to 197
Iodine value	- 125 to 154
Titre	- 18.1 to 18.2
Unsaponifiable matter	- 1.2

Fatty acids that this oil contains are given hereunder :

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	9.6
Stearic	6.3
Oleic	21.7
Linoleic	55 to 60

This oil is semi drying type. It can be used upto limited extent in paint and varnish industry. After suitable refining this oil is used as edible oil in some of the developed countries like Germany, Greece etc. Due to high saponification vlaue it can be used as raw material for soap. It is also used for pharmaceutical preparations, and in alkyd resins. The oil acts as insecticides and eliminates white ants. The signifiant superiority of this oil over that of linseed oil is that it does not turn yellowish on storage. It gives a better performance in the preparations of varnishes, ready mixed paints and superior enamels. It forms a good glossy adhesive film which is flexible and has water and electricity resisting characteristics.

After extracting oil what remains is oil cake. The cake is a good manure particularly for sugarcane and paddy. The composition of cake is as follows.

Crude protein 26 to 28 per cent, Sulphur Carbohydrates 30 to 32 per cent, Crude fibre 20 per cent. Ash 60 per cent, total Nitrogen 3 to 4 per cent and oil 1 to 2 per cent (depending on efficiency of extraction).

With negligible toxic matter and high protein and carbohydrates, this cake can be a good cattle feed too.

Tobacco dust is the by-product from tobacco industry. Except mixing a little in few zarda preparation it usually goes waste. It should be noted that the dust and other waste materials of tobacco fertilizes the soil, make it absorb more water and soil structure is improved. Tobacco waste also contains 0.6 to 4 per cent Nicotine Sulphate which is an effective insecticide. While we allow this valuable tobacco waste go waste, we import Nicotine Sulphate draining valuable foreign exchange. From stems of virginia tobacco good quality of salt manure, viz., Potassium Sulphate can be produced :

Tobacco plays an important role as medicine too. The oil from this species is bitter and sharp and can be used as germicidal. It cures cough, cold, lungs trouble, stomach pain and dental trouble. By smoking tobacco leaf, it is believed that it helps patients suffering from hernia and gas trouble. According to Hakimi system of treatment tobacco leaves are used for curing various ailments. Warm tobacco leaves mixed with butter or ghee when applied on the chest just above lungs externally removes breathing difficulties. By tying warm tobacco leaf on stomach it gives relief in stomach trouble. Desi tobacco mixed with ginger juice is used for curing asthma. Similarly white ash formed in the pipe of the smokers cures asthma.

Tabacco is used in various way to cure the ailments connected with tooth and gum. The juice of green tobacco leaf boiled with equal proportion of til oil in low fire for sometime and then filtered and preserved. This preparation is applied to teeth and gums to cure pyorrhea. Tobacco leaves rubbed on dental gums removes swelling. Surti tobacco leaf, black pepper and Sambhar salt is mixed in the proportion of 1 : 1 : 2 is grinded into fine powder and cures toothache, gum trouble and swelling of gums simply by rubbing.

Tobacco leaf, Neem leaf and dry dhaniya is mixed and grinded into fine powder if taken as snuff cures the cold. The paste in water of tobacco leaf and lavang if applied on forehead of the portion of half headache removes the pain. The tobacco leaf poultice cures the sprain. Tobacco flowers grinded into paste in Karanja oil and if applied on bald portion of head cures baldness. Ash of tobacco flower made into paste in til oil if applied cures baldness. Tobacco leaf water has capability of removing lice if used appropriately. In eye diseases also tobacco can be used. It cures cataract if used castor oil, finely ground tobacco leaf powder cures watery eyes and tobacco soot from pipes with soap cures night blindness. Tobacco leaf also helps in curing skin diseases, bees and insect stings and snake and dog bite. Tobacco flowers are useful for curing boils.

Tobacco do have certain well known evil effects too. Smoking causes dreaded cancer, gastric trouble, heart trouble and breathing trouble. Tobacco chewing, eating and smoking in excess results in poisoning, the blood and causes low pulse beating. Ladies who smoke tobacco are affected most. They lose beauty, their genitals become weak and quickly they become old. They often suffer from abortion. Their progeny becomes weak and remain unhealthy.

Yet with all above tobacco is a valuable wealth of India. It gives us much more than a gift to smokers pleasure and mans woe. However Ayurveda suggests if smoking is done scientifically it helps our health rather than evil. However, let us not raise controversy but instead let us use tobacco for total growth.

CHAPTER 21

SURYAMUKHI

Suryamukhi till recently was growing wild in India besides as garden crop for beauty of its flower. It is called Suryamukhi as it is believed that the flower always looks towards the Sun. Infact it is so called in almost all Indian languages but known as Sunflower in English, known as *Helianthus annuus* Linn. in botanical nomenclature belonging to compositae botanical family, this plant gradually became one of the chief source of our edible oil. It has an added advantage that it grows well everywhere irrespective of soil and climatic conditions. It was first commercially grown in Russia, Hungary, Yugoslavia, Rumania and Bulgaria as oil seed plant, initially to adulterate olive oil but later itself became popular edible and salad oil. In India it has already become a popular edible oil irrespective of region since it is odourless and secondly it is healthier. In world scene oil seed production, Sunflower seed has acquired third place.

The Suryamukhi plant yields saponins having various pharmaceutical use. Triterpene saponins of the plant on acid hydrolysis yield a new triterpene dihydroxy acid, named helianthic acid. Leaves contain ascorbic, citric and malic acid and carotene. Hence leaves can be an important source of vitamin-C and can be used as preservative and helpful for pharmaceutical and chemical industries. Leaf extract is reported to be antibacterial. Trace elements in leaves are also reported.

In entire plant however, seed is most valuable. It is reported that the seed contains a number of amino acids. However the plant itself is cultivated because of its oil. The seed contains about 22 per cent oil while the kernel over 30 per cent. The properties of Suryamukhi oil is as follows.

Properties of Suryamukhi Oil

Colour	- light yellow
Consistency	- liquid, transparent
Sp. gravity at 15.5°C	- 0.920 to 0.926
Refractive index at 25°C	- 1.473
Saponification value	- 186 to 194
Iodine value	- 120 to 140
Unsaponifiable matter	- 1.3 to 1.5

Fatty acid composition of Suryamukhi oil is given below.

<i>Fatty acid</i>	<i>Per cent</i>
Palmitic	5.6
Stearic	4.4
Arachidic	1.4
Linoleic	56.8
Oleic	31.1

The oil is increasingly used as a popular edible oil both as cooking media as well as salad oil. It can also be used for manufacture of soap, paint and varnish industries. But due to its prohibitive cost now a days, the use in non edible industries are being discouraged. It is also employed as a base in pharmaceuticals

The oil cake contains protein, amino acids and minerals but no toxic matters hence can be an ideal cattle feed. Processed cake can also be consumed by homo sapiens. Due to its NPK value it can be a good manure too.

Flowers, not only adds to the beauty of our house but also can help growth of beekeeping industry. This industry can flourish even where there is wild growth of this plant.

This small plant has already become an asset in our country, it will become more dearer if we utilise more effectively.

CHAPTER 22

KARDI

Kardi, also known as safflower was a popular edible oil in Karnataka and Maharashtra till recently. But due to high content of polyunsaturated fatty acids, it has earned all India popularity particularly for cardiac patient. It is known as Dyers saffron in English, Kusumba or Karrak in Hindi, Kusube in Kannada, Karadar in Marathi and Karada Kusumbo in Gujrathi. In botanical nomenclature it is called *Carthamus tinctorius* Linn., belonging to compositae botanical family. It was also a popular dye plant. Besides India it also grows as bushes in Afghanistan and Abyssinia

It is reported that the Kardi plant contains 0.7% of Luteolin 7 - glucoside. It can be utilised for various drugs and pharmaceutical preparations. The flower gives a colour dye of Kesari or saffron colour popularly known as Kusumb. The flowers also contain 3 - rhamnoglucoside of β -ferol which has various pharmaceutical utilities. Since the flower has the nectar, there is possibility of growth of beekeeping industry.

The Kardi seed contains 25 per cent oil while its Kernal contains 35 per cent. The properties of Kardi oil is given below.

Properties of Kardi oil

Colour	- Dark reddish brown
Consistency	- Liquid
Specific gravity at 15.5°C	- 0.9243
Saponification value	- 190
Iodine value	- 150
Unsaponifiable matter	- 1%

Fatty acid composition of Kardi oil is given below.

<i>Fatty acid</i>	<i>Per cent</i>
Palmitic	6.4
Stearic	3.0
Arachidic	0.2
Oleic	13.4
Linoleic	77.0

Semi drying characteristic of oil is useful for paint and varnish industry. It has used as edible oil locally but now it has all India reputation for higher polyunsaturated fatty acid suitable for cardiac patients. It can also be used as a raw material for soap industry. By cracking the fat we can get individual fatty acids and glycerol which can be used for various purposes.

Oil cake can be a good cattle feed. High protein and carbohydrate content can be aid to the health of the cattle. Due to high NPK content it can also be a good manure. The leaves of this plant can also be utilised for green manuring.

Kardi is now being cultivated in Karnataka and Maharashtra but elsewhere it grows wild, and often victim of afforestation and deforestation. This bush is already proved commercial and should grow as cultivated crop for over all growth of our nation.

CHAPTER 23

ASHWAGANDHA

Ashwagandha is one of the most popular medicinal shrub in India. Various parts of this plant was used as medicine according to Ayurveda and was used either raw or as part of medicinal preparations since vedic era. It was referred frequently in Atharva Veda and other scriptures. However botanical species *Withania Coagulans* Dunal, *Withania Semnifera* Dunal, and *Withania ashwagandha* Kaul all belonging to Solanaceae botanical family. According to Ayurveda however all these species are called ashwagandha although they have different uses for different preparations.

Seed oil of coagulans variety is screened for linoleic acid-rich oil for therapeutic value in preventing atherosclerosis.

By extracting with 45 per cent alkali the *Somnifera* plant yields highest percentage of alkaloids. Isolation of nicotine, Somniferine, Somniferimine, Withanine, Withananine and Pseudowithanine is reported. Alkaloids and Chemicals, notably sucrose, β -sitosterol, a few acids and a neutral compound can be isolated. Occurrence of isopelletierine in the roots is reported. Roots also contain tropine, pseudotropine, 3 α -tigloyloxytropine, Choline, Cuscohygrine, di-isopelletierine, and new alkaloids anaferine and anhygrine.

Leaves and roots have antibiotic activity against *Staph. aureus*. Leaves contain withanone having empirical formula $C_{24}H_{32}O_6$. Therefore both root and leaves do have medicinal properties and can be used as medicine as it is. However if chemicals and alkaloids are isolated we can have many more preparations. It is reported that the berries contain useful amino acids and protein. Hence if processed properly the berries can

become useful nutritious food. Berries also contain various organics including alkaloids hence can be useful medicines too. Total alkaloids reported in ashwagandha variety is 0.20 per cent.

Therefore, this shrub if cultivated can give answers to many of our health problems.

CHAPTER 24

KOKUM

Kokum is a small evergreen plant grows upto 15 to 18 metres. It usually found in tropical rain forest of Western ghats, Meghalaya, West Bengal and Assam upto the altitude of 6000 ft. on slopes down upto coastal area. It is called Murgal in Tamil Punampuli in Malayalam, Murgala in Kannada, Wild mangosteen or red mangosteen in English, Tintuli in Oriya, Kokum in Hindi, Atyamala or Raktapurak or Vrikshamla in Sanskrit and Kokum or Amsul or Ratanba in Marathi. In botanical language it is called *Garcinia indica* choisy belonging to Guttifera botanical family.

Kokum leaves are oblong, lance shaped reddish when young which turns green later. The leaves contain essential oil and medicinal often used as food. Its root is medicinal and is astringent.

Flowers appear between November to February, small fleshy, dark pink and appears sometime solit / or sometime in spreading clusters. There is good scope for growth of beekeeping industry during the flowering season. Kokum honey is viscous, reddish and tasty, have good consumer appeal.

Fruits appear during April and May, spherical shaped and ungrooved berry. They are 2.5 to 3 cm. in diameter, purple when ripe with a yellowish tinge. Pulp is anthelmintic and cardi tonic. The dried rind with pulp is the main commercial product used for currys and syrups to bring sour taste.

About 20 to 23 per cent of the fruit is seed, each fruit containing about 5 to 8 numbers, compressed embedded in acid pulp. About 60 per cent of the seed is the Kernal. Seed contains about 23 to 26 per cent oil while Kernal about 44 per cent. Fruits are usually hand picked, the seeds are separated and the pulp is sold as principal product. The seed then be decorticated to take

out the Kernal. Oil may be extracted first by a expeller yielding 34 to 44 per cent followed by solvent extraction clear oil can be obtained by hot filtration. The properties of Kakum oil is given below.

Properties of Kokum oil

Colour	- Grey white
Odour	- None
Melting point	- 41 to 42°C
Consistency	- Hard and brittle
Refractive index at 40°C	- 1.4565 to 1.4575
Iodine value	- 25 to 36
Saponification value	- 187 to 191.7

Fatty acid composition of Kokum oil is given below

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	2.5 to 5.3
Stearic	52 to 56.4
Myristic	1.2
Oleic	39.4 to 41.5
Linoleic	1.7

It is normally found as solid fat at room temperature traditionally used as vesseline for crack to skin. Consumed also for dysentery Properties similar to tallow, hence useful in sizing of cotton yarn, manufacture of oinments, cosmetic preparations, suppositories and pharmaceutical products. It is also considered medicinal as nutritive, demulcent, astringent and emmolient. About 75 per cent of its Glycerol is in the form of mono-oleo-disaturated Glycerides. Rich in combined stearic and oleic acid, both if isolated can be used for various purposes. About 45 per cent stearic acid can be recovered. By Alkali treatment and bleaching, the fat can be turned equivalent almost to hydrogenated fat. There is good scope for the fat to be used for manufacture of chocolates.

After extracting oil what remains is oil cake. Oil cake contains 16.5 per cent protein, 57.27 per cent carbohydrates. It does not contain any toxic principles but has a sour taste which can be

eliminated by washing with water. Out of 13 present, 9 are essential amino acids. It can also be used as manure and also for manufacture of adhesives.

This tree usually grows wild planted rarely, mostly in South India. Considered normally as non-commercial since its virtues are not yet being exploited properly. The plant grows without much care since it is a natural plant in India. All these advantages should be fully exploited for sustainable growth.

CHAPTER 25

SITAFAL

Sitafal tree a medium sized evergreen tree grows almost all over India. It grows upto 3 to 5 metres. It is popular for its tasty fruit known by the name of the tree. It is also called ataphal in Bengali, Sugar apple in English and Sharifa or Sitafal in Hindi. In botanical nomenclature it is called *Anona squamosa* Linn., belonging to Annonaceae botanical family.

The bark and the root of this plant considered medicinal in some places particularly for breathing troubles. It is also believed that the root heals bad wounds. The green leaves yield about 0.08 per cent pleasant smelling essential oil.

Fruits are about 10 cm in diameter when ripe, round with uneven surface. Both ripe and unripe fruits are green in colour. Pulp is white, soft but in shape of flakes surrounding a number of seeds. The pulps are extremely sweet and nutritious containing both glucose and sucrose. It is reported to have contain vitamin C and a number of minerals. Besides being a good stimulant it is believed to prevent cold and cough coolant mild laxative and good for stomach. Nevertheless it is popular as a tasty fruit popular all over India.

Seeds are black in colour oval shaped with pointed at the end. They are about one cm. in length and half a cm. wide. Each seed contain one or two Kernal. Seed itself are believed to be potent insecticide seeds contain about 14 per cent oil and kernals 27.1%. Properties of Sitafal oil is given below :

Properties of Sitafal Oil

Consistency

Liquid

Specific gravity at 15°C	- 0.9126
Refractive index at 60°C	- 1.4558
Saponification value	- 188.3
Iodine value	- 85.6
Acid value	- 1.8
Unsaponifiable matter	- 0.2%

The oil contains following fatty acids.

<i>Fatty acid</i>	<i>Percentage</i>
Oleic	18.1
Linoleic	55.2
Palmitic	14.7
Stearic	10.7
Cerotic	0.9

The oil can not be used as edible due to presence of a number of toxic lipid associates. However it can be used as a raw material for soap but upto certain extent since with excess use the soap may tend to become softer due to larger proportion of unsaturated fat. It can however be used at larger proportion after hydrogenation. Due to presence of lipids it can be an effective insecticide. International Rice Research Institute, Manila, successfully prevented pest attacks and diseases of rice by spraying Sitafal oil. The oil can be further cracked to give us individual fatty acids and Glycerols so that its use can be further broadened. If the fat cracking be done after isolating lipids it shall be used for various other purposes too.

Oil cakes can not be considered as cattle feed due to presence of lipids. However due to presence of NPK, Carbohydrate and protein it can be a good manure and useful for adhesive industries. Besides being manure it can be an effective insecticide due to presence of lipids hence it will serve as dual purpose in our agriculture.

Inspite of being a popular fruit it is not cultivated

commercially in India. It grows as a natural vegetation and fruits are consumed during the season. Hence collection of seeds, leaves etc., becomes difficult since the trees are found scattered. For full utilisation of its virtue, its plantation should be planned appropriately as a part of afforestation programme.

CHAPTER 26

KAMLA

Kamla tree is a small evergreen tree available in plains and hilly forests throughout tropical India along with the foot of the Himalayas from Jammu and Kashmir eastward upto the altitude of 5000 ft. all over the Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, West Bengal and Assam. It is also known as Kapila, Sinduri, Puudum, Senduri, Raini, Rohni, Thanatha and Shen Koth in various Indian languages. It is known as *Mallotus philippinensis* Muell., according to botanical nomenclature belonging to Euphorbiaceae botanical family.

In Uttar Pradesh, its fruits are collected as minor forest produce and exploited for the collection of red colour pigment which is found as a thin coating on the upper most surface of the fruits. This colour pigment is locally known as Kamila and Ruien. This is generally used for medicinal purpose, incense dye and ammuation etc. The fruit not only contains dye but also essential oil. Kamla fruit contains rottlerin in its pulp which has anti-fertility effect. The fruit after maturity, dried and powdered can be used as a oral contraceptive at appropriate dose.

As being practised today, the fruit after extracting the colour pigment were generally discarded. Due to the demand of the dye for various purposes, the fruits before maturity often collected without bothering about its yield or even various uses as a result this goes as a gross national waste. Each fruit contains on an average three small black seeds which is basically a oil bearing seed. About 60 per cent of this seed as a pale white Kernal containing about 32 to 35 per cent oil. But extraction of oil from seed by mechanical methods is extremely difficult since the oil is extremely viscous and jelly type. It can however be extracted easily by solvent extraction method. Since oil as such as not edible in nature cheaper solvents can also be used subject

to the end use of the oil we decide upon. The properties of Kamla oil is given below.

Properties of Kamla Oil

Consistency	-	Viscous
Specific gravity at 40°C	-	0.9409
Refractive index at 30°C	-	1.5052
Saponification value	-	195.0
Iodine Value	-	166.0
Acid Value	-	6.4
Unsaponifiable matter	-	1.7%
Diene Value	-	40.4

Fatty acid composition of Kamala oil is given below.

<i>Fatty acid</i>	<i>Per cent</i>
Kamlolenic	57.5 to 58.5
Conjugatediene	2.0 to 4.5
Linoleic	11.7
Oleic	13.3 to 19.6
Lauric	0.1
Myristic	2.1 to 2.5
Palmitic	7.4 to 8.7
Stearic	0.6 to 0.7

The oil can be used as raw material for manufacture of soap due to its high saponification value. But at the same time it can not be used at high percentage since the soap shall tend to be soft. The oil is extremely good for manufacture of paints and varnishes, particularly for bringing air drying wrinkle finish on a surface which can not be baked. The oil on further processing gives hydrokystearic acid, a commercially important organic intermediate. In fat cracking we can also get individual fatty

acids and glycerol whose uses need not be described again and again.

Oil cake however is unfit as cattle feed. But it can be used as a manure and insecticide. Various alkaloids also can be isolated from the cake, hence can be used for various purposes.

This neglected vegetation can be a boon if utilised appropriately. But till recently this is a victim of afforestation and deforestation.

CHAPTER 27

ARGEMONE

Argemone plant is a small plant that grows wild throughout the country. It is popularly known as Mexican poppy or prickly poppy in English besides Bila detura in Hindi, Darudi in Gujrathi, Datturi or Daruri in Kannada besides Suvarnakeshari, Shaikanta, Brahmadandi, Satyanashi, Kateri and so on in various other Indian languages. In botanical nomenclature it is called *Argemone mexicana* Linn., belonging to Papaveraceal botanical family.

Various part of this plant contain various alkaloids and toxic principles which if isolated can be utilised for various purposes including drugs and pharmaceuticals. The roots contain various alkaloids principally protopine, and allocryptonine. The plant in total yields 0.125 per cent total alkaloids, notably protopine (0.084%) and berberine (0.125%) both having various pharmacological utilities. In the roots of both *Argemone alba* and *Argemone mexicana* contain alkaloids α -allocryptoring, β -allocryptonine, berberine, Sanguinarine, Chelerythrine etc. These alkaloids in different proportions are also reported in aerial part of the plants too.

The most valuable part of Mexican poppy is its seeds. The seeds contain ceryl alcohol which can be isolated to be used for various purposes. The seeds also contain the alkaloids like protopine, allocryptonine etc., in sufficient proportion. It contains tannin, resin and various toxic substances. Above all the seed contain 32.5 per cent oil whose properties are given below.

Properties of Argemone oil

Specific gravity at 30°C	-	0.9177
Refractive index at 40°C	-	1.4691

Saponification value	-	188.2
Iodine value	-	49.8
Acid value	-	3.5
Unsaponifiable matter	-	1.1%

The fatty acid composition of the oil is as follows .

<i>Fatty acid</i>	<i>Per cent</i>
Palmitic	8.57
Stearic	4.53
Palmito-oleic	2.31
Oleic	26.23
Linoleic	47.66
Linolenic	2.90
Richnoleic	7.80

The oil is unfit for human consumption for its toxic ingredients. But can be considered as a good raw material for soap due to high saponification value. After isolating toxic lipids and then fat splitting we shall get the individual lipids, fatty acids and glycerol, all of them can be utilised for various purposes.

The oil cake is unfit for cattle feed due to its toxic components. However alkaloids can be isolated from cake too for various uses. Due to its NPK and protein content it can be used as manure and in adhesive industry and can be an effective pesticide also.

This plant usually grows wild and is a victim of both afforestation and deforestation. Effective utilisation of its virtue becomes difficult due to its scattered growth.

CHAPTER 28

BAOLI LATA

It is a creeper usually grows near the edges of mangrove swamps. Obviously it is commonly found in Sundarbans in West Bengal and Bangladesh besides Nicobar islands and Western Malayasia. Known as *Sarcolobus globosus* wall., in botanical nomenclature belonging to Asclepiadaceae botanical family.

The plant, particularly the seeds, used for poisoning wild animals like tiger and wild hogs. Sometimes criminally used by thieves to kill watch dogs. The poisonous substance is a type of resin.

The leaves recommended in a paste made with Aleuritico nuts, for rubbing on the joints in what may be either rheumatic fever or dengue fever.

Not much work has not been done as yet. There is need to study more. The resin used as poison need to be analysed Alkaloids present need to be identified and method to isolating them should be determined. The components that relieves rheumatic fever should also be identified to give us many more answers.

CHAPTER 19

PISA

Medium sized, evergreen, shade and moisture loving tree is Pisa which grows wild in evergreen forests of Western Ghats of Maharashtra, South Kanara district of Karnataka, east coast forests of Orissa besides Assam and Sikkim. The tree grows upto the height of 12 to 15 metres and matures in 12 to 15 years. It is called Pisa in Hindi, Thalī in Tamil, Jarohampa or Jadambu in Oriya, Malavirinya in Malayalam and Tudgenasu or Haggodagi in Kannaḍa. This plant belongs to Lauraceae botanical family and called *Actinodaphne argustifolia* Nees and *Actinodaphne hookeri* Meissn., in botanical nomenclature.

The leaves of this plant are medicinal and used for various purposes locally. Dried powder of leaves with milk or water is used as a tonic and believed to be a good stimulant. Flowers appear in the month of November to January. This yellow flower contains essential oil which can be extracted by steam distillation. It is extremely useful for breeding honey bees.

The Pisa fruit appears in the month of May and June. It is an ellipsoidal berry 0.8 to 1.3 cms. long and pulpy. It is red when ripe. One fruit weighs 25 gms. In dried fruit 46.8 per cent is skin and pulp while 53.2 per cent is the seed. Pulp and shell contain an oil having unsaturated fatty acids. Pulp and skin contain 51.1 per cent oil while Kernel contains 74.6 per cent. Oil is extracted by pressing entire dried fruit. The oil having solid consistency with 90 to 96 per cent trilaurin, hence best substitute for coconut oil in industries such as soap. Lauric acid itself is useful for production of Lauryl sulphonate. Lipid associates particularly a lauryl ester is an aromatic principle may be useful as a flavouring agent. The properties of Pisa oil are given below.

Properties of Pisa oil

Colour	- Yellowish brown
Odour	- Strong, aromatic
Consistency	- Crystalline
Refractive index at 30°C	- 1.4490
Specific gravity at 25°C	- 0.925
Iodine value	- 8.5 to 10.9
Melting point	- 43 to 44°C
Saponification value	- 255.5 to 257
Unsaponifiable matter	- 1.5%

Fatty acid composition of Pisa oil is

<i>Fatty acid</i>	<i>Percentage</i>
Lauric	96
Oleic	4

Pisa oil cake is a good manure and used as cattle feed. Leaves are used for green manuring.

CHAPTER 30

JUTE

Jute is the internationally recognised name of the bast fibre obtained from the stalks of a cultivated plant by same name. It is called Titamara or Maraput in Assamese, Jhota in Oriya, Pat or chinalitapat or nalita or narcha or titapot in Bengali. There are about 40 species of jutes out of which only 8 varieties occur in India. Out of 8 varieties, the two are most common having botanical names *Corchorus capsularis* Linn and *Corchorus olitorius* Linn. both belonging to Tiliaceae botanical family.

The more common of the two-capsularies which accounts for nearly 75 per cent of the cultivated area, is reported to be growing wild in China. It appears to have come from China to India. The preference for this species is due to the fact that it grows both in high and low lands; withstands water logging and can be sown and harvested earlier enabling the cultivator to raise a crop of transplanted rice after the jute harvest in June and July. Agriculturally the distinction between the early and the late varieties is important. For low-lying areas which are subject of early floods, an early maturing variety is required. A number of improved varieties are now under general cultivation. Some are high yielders with better quality fibre, suitable for low lands. Some are early maturing and at the same time high yielding. Some are late maturing and at the same time high yielding. Some are tall varieties. Nevertheless they have tall straight slender stalks. On an average their height ranges from 1½ mtrs to 5 mtrs. The diameter of the stalk being 1 to 2 cms.

The use of jute for fabrics and cordage is of great antiquity. Exports of gunny bags in 1746 and 1755 from India to England are the first recorded instances of any jute products sent of Europe in modern times. Jute was first spun experimentally in England in 1820 and was commercially established in the year 1850.

Jute is one of the most important fabric crops of the world, the quantity of the production is exceeded only by cotton. Most of the production is from Bangladesh. India is following closely both in quantity and quality. These two countries account for over 80 per cent of the world production. Iran, Nepal, Thailand, Vietnam, Taiwan and China are the other producers. W. Bengal, Bihar, Assam, Tripura and Orissa are the principal jute producing states of India.

Jute is essentially a rainy season crop. The plants grow best in a rich sandy loam. The areas should be well drained though some varieties are suited for the low land areas. A relative humidity range of 65 to 90 per cent is most beneficial.

The new rich alluvial soils brought down by the Ganges and the Brahmaputra and their tributaries have proved ideal for the crop in India and Bangladesh. A fine seed bed is required for the sowing. The land is prepared by ploughing and then by cross ploughing. The clods are broken up till the soil is well pulverised. This is because the seeds of jute are extremely small.

In low lands the seeds are sown early from mid-February to mid-March. In medium lands they are sown from March to May. The plants depend entirely on sub soil moisture and the occasional showers till monsoon sets in. 5 to 7 cms of rain during the sowing period and 3 to 5 cms per week thereafter suffices. Jute tolerates any amount of rainfall when full grown. But young plants are sensitive to water logging.

Plants become ready for harvesting about 120 days after the seed is sown. Thus capsularis is generally harvested between June and September and Olitorious between August and September. There are three plant stages for harvesting (i) when in flower (ii) just after the flowers are shed and the fruit has began to set (iii) when the fruit is fully developed.

A large area of the finest jute area is usually double cropped with jute sown in March-April and reaped in July-August and transplanted rice planted as soon as the land is prepared after the jute is taken.

The plants are cut close to the ground with sickles. In some parts the practice is to leave the stubbles 7 to 10 cms high above the ground. While this lowers the percentage of roots in the fibres, it lowers the yield.

Retting is the process by which the fibre which is just under

the bark of the stalk is prepared for the removal from the stalk. Essentially it consists in the soaking of the stalks in water until bacterial action makes it possible to free the fibre easily from the stalk, washing it clean from all gummy substances, and bits of the bark that may remain on it. Jute is retted either in stagnant water or in slow running water. The latter method gives better quality jute.

The break down of the tissues which is caused by the combined action of water and micro organisms follows a definite sequence; the cambium becomes attacked first. The thin walled ray cells and the soft tissues of the Phloem are next to disintegrate and finally the cortex becomes disorganised. Retting is complete when all the soft tissues are dissolved and the fibre bundles become separated. The retting period varies with thickness of the stem. The top portion takes 5 to 6 days, the middle portion 9 to 12 days and the basal region 15 to 20 days. Thus retting takes from 10 to 20 days. Retting is quicker when the temperature of water is high, not less than 27°C. The temperature of running water is generally lower than that of stagnant water. Rate of retting also varies from season to season. Immature crops take a shorter time as the quantity of tissues to be disintegrated is greater in case of the mature crops; the tissues are harder in the latter case. The quantity of suspended and dissolved particles in water also influences rate of retting. Retting has to be done carefully and frequent inspection is resorted to since under retting shall create difficulties to remove the fibres from the stalk while over retting shall be the cause of production of inferior quality fibre with less strength and devoid of lustre.

When the retting is complete the bundles are removed from the water, for stripping the fibre. After beating the root ends, the fibres thus loosened are wrapped round a finger and stems are jerked forward and backward in water where by the fibre is separated from the sticks. The fibre is then washed, bite of sticks adhering are removed, the water is squeezed out, and the jute piled on clean ground. This raw jute then further processed depending on end product. It is first chemically processed, followed by carding, then converted to sliver finally spun as yarn. The yarn is then woven and sized to give us desired end product.

The fibre content ranges from 4.5 to 7.5 per cent of the green weight of the stalk. The average is about 6 per cent. The colour of the fibre varies from silver to pale cream to purplish grey. When properly grown, retted and washed, it is fairly lustrous and has moderate strength. Jute is weaker than flax or hemp, but stronger than Kenef (Bomli) or roselle. Jute is weaker in a soaked or in a wet condition. Sann hemp yarns are much stronger than jute, but they are coarse and cannot be spun to such a high counts as jute.

Jute is used principally for making coarse woven fabrics such as hessian and sackings required for containers to store or transport a large variety of commodities. It is used for linoleum backings and in conjunction with cotton yarns for carpets. Cotton - jute combinations are used for deck - chairs, and awnings, mattress covers and underlays. Jute is also used for roofing fabrics, sandbags, tents niwars, canvas, kitbags, tool bags, baggage covers etc. It is used for making twines, cordages and roped for building purposes. Wool - Jute, Cotton - jute and flax - jute blends are made into a variety of utility fabrics. Jute waste can be used as raw material for manufacture of high quality tissue paper and viscose rayon. With better method of processing, jute is being used as furnishing, even as dress material. With further research, jute can be used in plastics, for production of nitro cellulose, lacquers and artificial silk. Infact bulk of artsilk now being sold in Calcutta is made of jute.

After extracting jute from stalk what remain is jute stick, so popularly known as patkathi in West Bengal and Bangladesh. It has important use in many of our rituals including last rites hence gets through the market of both the Bengal. It was used as torches traditionally. But it should also be noted that it also contain cellulose and fibre hence can be used as raw material in paper industry. It can be compressed into insulating boards.

Jute was always considered as a fibre plant hence its seeds are never considered as important commercial product. It is reported that seeds of capsularies contain two digitalis Glycosides Corchoroside A and Corchoroside B, besides a bitter principle corchorin. Seeds of olitorius variety also contain Corchoroside A and B. If isolated they can be effectively used as pharmaceutical intermediates. Jute seed is small with depressions in the middle of one of the sides. Seed of

Capsularies is reddish brown in colour, bold in size and well shaped while that of Olitorius is grey in colour small in size and ill shaped. Jute seed contain 13 per cent oil and 17 per cent protein. Raw jute seed oil is orange coloured. The free fatty acid contents of oil from one year old seed are still low showing thereby that seed keeps well on storage. The oil can be used for edible purposes. The oil cake can not only be used as cattle feed for its high protein composition but is also medicinal and useful for manufacture of adhesives.

The principal product from jute plant however is the fibre for which the jute is cultivated. But the recent unfortunate trend has discouraged the cultivators to continue with this crop. Most of the prospective jute mills are still owned by either monopoly houses or multinationals. Only the sick mills are being run by the Government. The mill owner - trade union nexus frequently close the mills till the farmers go for distress sell of raw jute which benefit the mill owners out of which only a small fraction keeps mill workers and trade union leaders happy. The mill unions acts independently and raise slogans in favour of workers only without bothering much about farmers.

Although there is supposed to be a term called support price being implemented by Jute Commissioner of India but in real practice how much we succeed is a matter need to be assessed. Recently to counter this unfortunate trend mini jute mills were designed but its implementation still to take root since only one such plant is running at Kamarpukur by Rajkrishna Mission. The second problem being the cut throat competition from other fibres both synthetic as well as natural. As a result jute fibre is fast losing its market base. Last but not the least to solve the problems of jute, it was never considered as a serious national issue in India since jute is neither an all India product nor a product of Hindi belt. It is the product of poor Eastern India. Jute as a packing material is environmentally clean since it is biodegradable. Synthetic fibres shall only create environmental crisis during the years to come. Above all production of jute shall provide employment to a number of poor hands which the synthetic fibres do not. There is a need of the hour to save this genre from on slaught of modern trend which shall ensure better environment not only as a product but also as a crop. It shall also provide us medicines, edible oil paper and many more.

CHAPTER 31

BAEL

A few plant useful in many ways has been taken as part to our rituals perhaps to prevent onslaught or felling. Bael is one of such plant in India which is considered as one of the sacred plant by the Hindus. Known as *Aegle marmelos* Corr., in botanical nomenclature belonging to Rutaceae botanical family, it is also called Bela in Oriya, Bael in Assamese and Bengali, Siriphal in Hindi, Koovlam in Malayalam, Bilva phal in Gujrathi and Bilva in Sanskrit. While praying Lord Shiva, the Hindu god of destruction, but its leaves and fruits are used or otherwise it is believed that praying will remain incomplete.

This plant grows wild all over India and tropical countries, particularly at a lower altitude. It remains green almost round the year. The fruit both ripe and unripe has hard woody cover for which it is known as wood apple in English. The shape of the leaves resembles human eyes. Three leaves attached to a branch resembling the shape of trident considered to be sacred to Hindus.

Almost all parts of this plant has medicinal value. The root is useful for urinary troubles, pain in abdomen, palpitation of heart and meloncholia. Leaves are useful for fabrifuge and lever diseases but over use may reduce sexual capacity. Leaves yield β - sitosterol. It is also used as laxative and used for deafness and inflammations. Flowers are used for combating vomiting and dysentery. Unripe fruit is capable of removing pains and very useful for diarrhoea and dysentery. The pulp of ripe fruit Marmelosin which is an effective remedy for dysentery and constipation. The ripe fruit is also used as an appetiser, as a tonic (since it contain number of vitamins and minerals), a fabrifuge and improves functioning of heart. But frequent consumption of ripe fruit may cause increase of intertunal worm. Many standard

medicines like Quino bael, Quino gel etc., are manufactured from extracts of this fruit. Fruits yield essential oil containing d - α -phellandrene, besides the alkaloid like allo - imperatorin and β -sitosterol. The heartwood contains a ferro - quinoline alkaloid, dictamine, a dihydrofuro coumarin, marmasin and β -sitosterol.

Besides pharmaceutical uses there are various other uses too. Flowers during the season can promote beekeeping industry. In Bankura district of West Bengal the woody cover of the fruit is used for producing a sort of galands called Bael mala. After removing the pulp, the woody cover is drilled to produce small beads which is sewn into garlands. These garlands are traditionally worn by vaisnavites irrespective of sex are some time called Tulshi mala or sometime Bael mala. It has good market in Nabadweep or Mayapur of West Bengal, Mathura or Vrindaban in Uttar Pradesh, Manipur, Assam, Puri in Orissa and other places where domination of Vaisnavite cult is more.

The Bael seed yet to be exploited properly is a good oil bearing seed. The seed contains 11.9 per cent of oil while its Kernal contains 14.4 per cent. The properties of Bael oil is given below.

Properties of bael oil

Specific gravity at 30°C	- 0.918
Refractive index at 40°C	- 1.4647
Saponification value	- 193.6
Iodine value	- 108
Unsaponifiable matter	- 1.6%

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	16.6
Stearic	8.8
Oleic	30.5
Linoleic	36.0
Linolenic	8.1

Due to high saponification value it can be a good raw material for soap although if used at higher proportion soap may tend to

become soft due to higher composition of unsaturated fatty acid. It is yet to be determined whether it contains harmful lipids or not, if not it can become an ideal edible oil. By fat splitting we can get individual fatty acids and glycerol which can be used for various purposes as discussed before. But problem remains about collection of seeds since bael plants are found scattered since they are not a part of our planned plantation programme.

Except for the areas where bael is considered sacred it is a victim of both afforestation and deforestation, despite of its virtues. It is planted unplanned manner only for the purpose of helping our rituals hence commercial exploitation becomes difficult. It is time to think of cultivation this valuable plant appropriately for our sustainable development.

CHAPTER 32

AJAKARNA

Ajakarna is a large, handsome evergreen tree which grows upto 15 metres or more with 4.5 metres girth and are found commonly in moist evergreen or semievergreen forests of Western ghat and foothills from North Karara to Kerala. It is also found on deccan plateau along West coast from 60 to 1220 metres altitude. It also grows as avenue plant in parts of Karnataka and Kerala.

It is known as Ajakarna in Sanskrit, Safed damur or Kharaba in Hindi, Dhupa or Ral in Marathi, Indian Copal tree in English, Dhupada in Telugu, Paini or Piney in Malayalam, Dhup or Piney in Tamil, and Dhupa or Saldhupa in Kannada. In botanical nomenclature it is called *Vateria indica* Linn., belonging to Dipterocarpaceae botanical family.

Timber of this tree is never considered as a good timber. But it is commonly used for manufacture of spirit and varnish in safety match industry and for manufacture of plywood. Leaves are medicinal and are effective for green manuring besides cattle feed. Bark is used in traditional gur industry. Resin is considered commercial, popular as white damur. It is commonly used in varnish, candles besides as part of ointments and medicines. Hence it can effectively be used in pharmaceutical industries.

Flowers appear between January to March. It appears in terminal corymbose panicles, white and aromatic. There is good scope for growth of beekeeping industry in Ajakarna growing area. Essential oil can also be extracted from the flowers.

Fruits appear between May to July. It is oblong or round capsule, 6 × 4 cms., resembles Sapota in appearance. The fruit is fleshy, three valved with one seed, pale brown when ripe. The hard pericarp has a 6mm. thick brown pericarp of semifibrous

composition. Good crop appears every 3 to 5 years with 1 to 2 poor seasons and 1 to 2 average seasons in between. The fruit yields 1.06 per cent essential oil.

About 47 per cent of the fruit is Kernal. Fruit shell contains 25 per cent tannins which can be used for tanning hides as well as for pharmaceutical preparations. Coming back to Kernals, it may be mentioned that, average weight of the Kernal is 55 gms and is brittle and aromatic. They are usually reddish brown or green and has a thick brown covering Kernal contains 19 to 27 per cent oil fat. For the purpose of extracting oil the fruit should be collected immediately when fruit falls down to avoid germination in wet soil and infestation by worms. Fruits thus collected usually decorticated manually to get broken Kernals. Oil extracted from dried Kernal in three stages first by traditional water rendering method, second by expeller lastly by solvent extraction Properties of Ajakarna fat is given below :

Properties of Ajakarna fat

Colour	- White
Consistency	- Hard, brittle
Refractive index at 40°C	- 1.4576 to 1.4590
Melting point	- 30 to 40°C
Iodine value	- 36 to 43
Saponification value	- 187 to 192
Unsaponifiable matter	- 0.6 to 2.5%

Fatty acid composition of Ajakarna fat is given below

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	9.7 to 13.0
Stearic	38.9 to 13.0
Oleic	42.2 to 47.8
Linoleic	0.1 to 2.3
Arachidic	0.4 to 4.6

Due to its high saponification value, oil can be used in soap upto 30 per cent. Good fat even for toilet soap. May be

considered as edible but should be used carefully due to high saturation and lipids, can be effectively used in rheumatism and pains, useful for manufacture of candles. Also used in confectionery and as adulterant in ghee. Both seed and oil contains a lipid C-Glycodide - bergirin. However it is difficult to isolate from solvent extracted oil. If isolated it can be used in pharmaceutical industry. Fat also can be used for yarn sizing in textile industry. It can also be used in confectionery as cocoa butter substitute. However, the extra acidity of the fat corrodes the paint and machinery used for extraction.

After extraction of oil what remains is the oil cake. The cake is hard and unpalatable to livestock. However it is a good manure especially for coffee plantation. The cake is poor in protein and rich in N - free ether extract. Lipids can also be isolated from cake.

This plant is the victim of both afforestation and defforestation. It grew wild so far and there is need to prevent indiscriminate felling.

CHAPTER 33

KETKI

Ketki trees are trees with large narrow spirally arranged leaves. If permitted to grow, they reach a height of 9 metres or more. It usually grows wild near seashore that entire coastal India from West Bengal to down South and then upto Gujarat coast. It is commonly used as a hedge plant in coastal India and a source of essential oil used for edible purposes. In botanical nomenclature it is called *Pandanus tectorius* Soland belonging to Pandanaceae botanical family. In Sanskrit it is called Ketki while in Bengali, Hindi, Oriya, Gujarathi, and Marathi it is known as Ketki, Keya, Keora or Kiyu, in Malayalam it is called Kaida while in Kannada it is known as Kedge or Mundaka.

History records that these plants are indigenous to Mauritius where the natives were extracting the fibre from the leaves for manufacturing sacks for packing sugar, coffee and grains. It is reported that this valuable use of the plants was introduced in India sometime during 16th century. But fact that we find frequent mention of the fragrant flower Ketkin in our epic Sanskrit texts shows that those plants were naturally grown in India since epic era. However the plant was considered more as a source of essential oil in India rather than as a source of fibre.

As told it is popular in India as a source of aroma or essential oil. It is reported that entire plant yields 0.28 to 0.31 per cent essential oil while it is much higher in flower. It is extracted traditionally by boiling the flower in hot water and then filtering. The hot water after filtration is sold as Keora water which is used with drinking water or flavouring various food items or drinks. It is believed that the essential oil from Ketki is a good coolant and has digestive effect for which it is also used in herbal preparations both for stomach are as well as for external

body applications. Petals of Ketki flower is also used for final treatment of Katha, and this treatment not only adds aroma but also a peculiar taste with betel leaf.

The fruits of these trees can float in water for very long distance without being injured in any way by either salt water or fresh water. Thus they are come across on sea shores or on either side of streams and rivers. A few type of fruits are edible which are known for its aroma. However, further studies are necessary to find out the virtues of its fruit, seed Kernal etc. Since flower is the principal commercial product, people do not allow the fruits to grow at least at approachable distance. Fruits grow only where it is difficult to exploit and the fallen fruits thus helps further growth of the plant.

The branched stems of the plant bear numerous thick, adventitious roots which serve to anchor the plants firmly to the sandy soils. Thus they are found mostly in the tropics. They appear to be particularly well adapted to withstand the exposed conditions of the seashore. Among the tangle of the roots, fallen leaves and other organic materials become enmeshed, and by their decay serve to enrich the soil.

The leaves grow to a length of 2 to 3 metres or more. They are lanceolate. Their width in their widest part rarely exceeds 8 cms. They contain tough, longitudinal fibres which are white and glossy. Leaves are usually used for the manufacture of mats than for the fibres. Rarely are the leaves exploited for the manufacture of fibre. Fibres can be exploited only by the retting process. In India, cropping for the leaves (for the mats of course) commences in the third year, and harvesting is done in alternate years thereafter. In Madagagascar the fibres are extracted by splitting the leaves into shreds or fillets and then soaking them in water till the gums etc., adhering to the leaves are dissolved and washed away. This practice has already started in kerala where beautiful value added items are produced out of ketki fibre. The leaves contain 15 to 20 per cent fibres by weight. Like all other leaves which contains so high a percentage of fibres, mechanical decortication does not suit their extraction hence is not considered as a commercial product.

The roots too contain a kind of fibre which is spinnable. It is suitable for the manufacture of tolerably strong ropes. But they are not being used for this purpose. Here and there however

these fibres are utilised for the manufacture of brushes of white washing purposes.

The plant is not cultivated at any rate in India. It grows wild in the coastal belt and often felled due to the belief that it houses poisonous snakes. It continues to survive inspite of felling and exploitation of flowers since the plant itself in a very fast growing. In Orissa attempts were made to replace this plant by cash crops like Cashew. Systematic plantation and utilisation of virtues shall make this plant commercially viable and environmentally stable for our sustainable growth. Let its aroma spread further.

CHAPTER 34

BHANGA

Bhanga or hemp is cultivated in India principally for the narcotics, bhang, ganja and charas under a Government licence in only limited areas. The plant is considered to be a native of Western and Central Asia, but it is practically naturalised in the sub-Himalayan tracts. Infact, it is naturalised so much that it has entered in Indian culture as a part. Hindu ritual particularly while worshipping God Shiva or Goddess Durga. It is abundently met within waste lands from the Punjab east wards to Bihar, West Bengal and Orissa. The plant is cultivated to a small extent in Jammu and Kashmir and Kerala for fibre. In the district of Almora, both Pakri and Tehri Garwals and parts of the Nainital district it is permitted to be grown for the fibre. But the quality of Indian hemp fibre is extremely poor since the cultivation is not systematic. The story is different in other countries. It is grown principally for the value of fibre contained in the European countries, parts of China, Japan and U.S.A. In certain parts of Europe and American, and perhaps in China too it is grown for the seed that yields valuable oil. It also grows wild in India.

Known as *Cannabis Sativa* Linn., in botanical nomenclature, belonging to Cannabinaceae. It is commonly known in India Bhanga, Ganja, Churrus or Siddhi in Bengali, Assamese, Gujrathi, Hindi and Marathi, Ganzai or Kalpam Chettu in Telugu, Bangi in Kannada, Ganja or Bhangi in Tamil and Bhanga or Vijaya in Sanskrit. In English it is called True Hemp or Hemp.

Ganja is basically famous as narcotics besides for fibre and oil but is considered to be important source of medicine. Diluted extract of leave as Sarbat has narcotic effect but also relaxes nervous tension and cures many diseases. Ganja if smoked makes the body resistant to snake or scorpion bite.

There are many other uses too, Isolation of a sedative and antibacterial principle distinct from known constituents of hemp. Stem tips and leaves of plants cultivated in Europe yield phenolic acid fractions. The leaves contains two acids one of which possesses antibiotic properties and is related to Cannabidiol. Tetrahydrocannabinol and eight other phenolic compounds could be separated by Chromatographic separation method Volatile phenol fraction of charas gives eugenol and some guaiacol. Isolation and identification of piperidine and other amino acids are also reported.

A high content of very active and antibacterial and analgesic substances are found in Indian variety of *C. Sativa*. Bactericidal effects observed on Gram - positive micro-organisms, in some cases upto a dilution of 1 : 1,50,000 utilisation of these substances from Bhanga in veterinary medicine, e.g. for anthroponoses, is suggested. Resin is also highly medicinal but further study has to be made.

The use of the plant for the fibre predates written history. Russia and few other C.I.S. countries produces about 50 per cent of the worlds output. Italy comes next with about 20 per cent. In point of quality the Italian hemp fibre stands first.

The plant requires a moderately rich, friable, well drained, sandy loam if the fibre is the aim. Different varieties have been developed taking into consideration the different climatic and other natural conditions. The seeds are either broadcast or drilled.

The stalks become ready for harvesting when the lower leaves begin to turn yellow. A few varieties require about three months and the others about four months from the date of sowing. In some areas the harvesting is done by hand labour while in some machinery is employed for harvesting.

Methods of extracting the fibres vary from country to country. Dew retting is employed in some countries including U.S.A.; snow retting is resorted to in some others. Water retting is employed in still others. In some of the areas, the stalks are retted immediately after the harvesting. In the others the stalks are dried in the fields themselves for about five days. Chemical retting has been tried but the processes have not given satisfactory results thus far.

The stalks are tied in bundles and are immersed in ponds or

slowly running streams until the bark including the fibres separates out easily from the woody stem. The duration of the retting varies in different localities depending on the temperature of water. In hot, damp weather 3 to 4 days might suffice. In cool, dry weather one to two weeks might be necessary. Dew retted hemp is grey while the water retted fibres are usually creamy white.

After retting, the stalks are dried in air. In a few instances they are mechanically dried. The bark is then peeled away by hand. To facilitate this the stalks are either pounded with mallets or they are run through a breaking machine. The fibres have next to be removed or separated from the strips of the barks. This is done by scraping away the woody portion as done in India where labour is cheap. In some countries breaking and scutching machines are employed.

The strands of fibres thus recovered are then cleaned or dressed by hackling which consists in drawing the fibres over hackles i.e. sets of upright steel pins mounted over a plank. The fibres thus obtained are rough. They are softened by pounding by hand or by running through a stamping or rolling machine. The fibres thus cleaned are sorted out into grades. The yield of fibre ranges from 100 kgs to half a Metric tonnes an acre.

Bhanga fibre is strong, lustrous and durable. When carefully prepared it has a light colour. Its principal use is for twines, fine cordage, fabrics chiefly canvas or tarpaulins, sail cloth and suckings. In America it is used in the manufacture of sponges. It is also used for chaulking boats, pumps, engines and other machineries. Due to its low ash content, the Bhanga stalks are used as raw material for production of tissue papers. The increase in the supply of jute, abaca, sisal and finally the synthetic fibres has given a set back to the cultivation of Bhanga as a fibre crop.

The plants remaining in the field after harvesting for fibre are allowed to set seed. They are cut after the fruits have ripened. Then the fruits are dried and threshed for seed collection. An average crop yields half a tonne to one tonne per acre depending on the quantum of female plants since only female plants yields seeds. Effective cross pollination may also increase the yield. Hence, bee-keeping industry shall not only help in increasing the yield but shall give us Bhanga or hemp honey. In India no

systematic attempts have been made either to collect the seeds from plants or to raise crops for seed purposes.

The seeds give 32 to 35 per cent of Bhanga oil finds use in the paint and varnish industries as a substitute for linseed oil and in the manufacture of soap although the soap tend to be softer, since it has high percentage of unsaturated fatty acids. Hence it can be an excellent edible oil. It said to be an excellent medium for grinding colours. It is also used as a lamp oil. The oil cake can be used as cattle feed and manure.

There are two kinds of Bhangas found in India. One type is called Khurbhanga or Jungli bhanga. It grows wild throughout the sub-Himalayan regions in all situations attaining a considerable height during the season of periodical rains. This plant is of no use whatever. It contains insignificant quantities of narcotic matter except probably for a very small quantity of bhang. The recovery of it does not remunerate even the poorest class for the trouble bestowed on it. Nor, does it contain a fibre of the class that can be put to any use. The real bhanga is of the second type. It is the cultivated variety. It is grown chiefly on high lands on well prepared and abundantly manured soil close to villages or on recently cleared lands by burning primeval forests, the soil being rich to ensure a superior growth of the plant and an abundant crop without any manure for one season. In such places irrigation is not required. The best production comes from elevations of 1200 to 1500 metres above sea level. When the elevation is less than 1000 metres the heat becomes detrimental to the proper growth of the plants and the yield from such land is poor. Accordingly, the area between the Kumaon and Garhwal hills is acclaimed to be the best for this crop. However, this may be tried elsewhere where identical condition is existing.

Among the cultivated varieties too, there are two varieties - male and female. Male plants blossom, but the flowers do not set seeds. Only female plants set seeds. Hence yield of Bhanga oil depends on quantum of female plants. The best fibre obtained from the male plants, provided of course the plants are harvested at the right time. In properly cultivated land they grow to the height of 4 to 5 metres.

The stalks after being cut, are laid on the fields themselves to dry for a week or so. The seeds give Churrus. The leaves give

ganja, bhang and siddhi. The dry stalks when steeped in water for about 15 days in tanks or slowly flowing streams and beaten in mallets to give a superior fibre. It should be dried in the sun thereafter and stripped off and again beaten for a yield of soft fibres.

Therefore this wonderful plant which is basically used as the source of narcotics can give us much better useful products instead of injecting drug addiction in our society. The fibre is environmentally clean since they are biodegradable hence should be preferred against synthetics. Fibre alone can generate employment to thousands of people living below poverty line. Oil is healthy and can solve many of our social problems. Above all it is a source of a number of medicines. Let us discard its use as narcotics and encourage its other uses.

CHAPTER 35

MATTING RUSH

Matting rush belonging to *Juncus* genus is most common grass used for manufacture of mats not only in Indian but also in many other countries. About 30 species are come across in India. The most important out of them are the *Juncus effusus* Linn., *Juncus inflexus* Linn. and *Juncus Prismaticus* R Br., all belonging to Juncaceae family. The first two are very important from the view point of mat industry but all of them are medicinal.

Juncus effusus, commonly known as soft, common or matting rush and are found in Sikkim Himalayas (at 1800 to 3000 mtrs altitude), Khasi hills and Aka hills of Arunachal Pradesh in wet and marshy situation. Decoction of the pith is considered antilithic, pectoral and discutient. The Pith is used in China as diuretic and depurative and for keeping fistulous sores open. Root is diuretic. Plant itself is poisonous to cattles. The rush is used for making mats, baskets and chair bottoms. In China it is used as a binder twine in shops. In Philippines a fine string is prepared out of it. The pith is used for making wicks of lamps and candles.

Juncus inflexus Linn., are found usually in damp situations and distributed from Kashmir to Nepal, Arunachal Pradesh, Nilgiri hills, and Palni hills and the southern and of Western Ghats, ascending from the altitude of 1800 to 2700 mtrs. It is commonly known as hard rush. Plant is reported to be poisonous to animals, causes irritation of stomach and diarrhoea followed by nervousness and progressive blindness. The animal may die of cerebral haemorrhage preceded by convulsions. It is a tufted dark green perennial with a cylindrical stem. This rush too is used for manufacture of mats and baskets.

The mats can also be woven by plaiting in the case of these rushes.

The third variety, *Juncus prismatocalpus* is not commonly used as a fibre plant like the former two. It is found in the Himalayas from, Punjab to Assam, upto the altitude of 3000 mtrs., also in Tamil Nadu, Western ghats and Kerala in marshy places, pools and river banks. The plant is reported to be cyanogenetic. Although not as commonly as the former two it is also used for manufacture of mats, although quality is not upto the standard.

All these grows wild, but yet to be utilised to the extent of its virtues nor further investigations made.

CHAPTER 36

LAL AMBARI

Lal ambari is not a traditional plant of India but it was brought from West Africa and naturalised here. It is known as Roselle in English, Lal ambari in Hindi, Lal mista in Bengali, Yerra gogu in Telugu, Pulicclai Kerai gogu in Tamil, Pulachakri in Kannada and Chakiar in Assamese. In botanical nomenclature it is known as *Hibiscus Sabdariffa* Linn. belonging to *Malvaceae* botanical family.

As a source of fibre as well as decorative plant it was cultivated in various places in India. While West Bengal tops the list about the success of cultivation of this plant while it is also cultivated in Bihar, Assam, Andhra Pradesh and Tamil Nadu. Its fibre can substitute jute in various departments and the cultivation of this plant was preferred in many areas probably because it yields more fibre per plant, withstands draught and is not damaged by cattle. While it is encouraged as a fibre plant, its medicinal virtues were not exploited.

The plant is well adapted to all types of soils but thrives best in moderately fertile, well drained permeable soil. It requires a moist climate and a high temperature during its period of growth. It is sensitive to frost.

In Tamil Nadu and Andhra Pradesh Lal ambari is grown mostly on dry lands in rotation with other crops. Seeds are broadcast or drilled in May and June. It is an annual erect shrub with red or green stem, practically unbranched. It often attains a height of 3 to 5 metres.

For the purpose of fibre extraction, the crop is harvested at the bud stage just when the days begin to shorten. At this stage of its growth, both output and the quality of fibre are good. The stalks are tied into bundles, left on the field for 3 to 4 days and retted either in stagnant or running water.

The average yield of fibre is reported to be about 50 Kgs per acre, but astounding yield of 1 to 6 tonnes per acre has been recorded under favourable condition. Carefully prepared lal ambari fibre is creamy to silvery white and lustrous. It has moderately good strength.

Lal ambari is employed for sacking, cordage, rope, fishing nets and generally for all purposes for which jute is used. Bags made from this fibre is good for packing grains and sugar.

The flowers yield a yellow dye, flavonol glycoside hibiscitrin. It also yield, hibiscetin, gossypitrin and sabdaritrin, which can be isolated for various pharmaceutical and chemical use.

Its calyces are rich in acid and pectin and useful for jams and jellies etc. The principal water soluble acids citric acid, d - malic acid, tartaric acid and hibiscus acid. They contain gossypetin and hibiscin chloride, the latter reported to contain antiseptic properties.

Infusion of Calyces reported to be coolant and refreshing aid digestion and useful in bilious conditions. It is diuretic, choleric, intestinal antiseptic and mild laxative. It is also used effectively in heart and nerve diseases, high blood pressure and calcified arteries. Though reported anti scorbutic it is ineffective against scury.

This plant can now be called as an Indian and can be cultivated not only for its fibre but also for its medicinal virtues for our sustainable growth.

CHAPTER 37

JABA KUSUM

Worship of Goddess Durga or Kali is incomplete in India unless a garland comprising of 108 Jaba Kusum flower is offered. Perhaps due to its medicinal value, it was included as part of our rituals and since it is part of Hindu ritual it obviously grows all over India irrespective of climatic or soil condition. But it is never cultivated but grows either as a wild plant or as a garden plant for decoration or as avenue plant. It also grows in other neighbouring Asian countries.

Known as *Hibiscus rosa - sinensis* Linn., as per botanical nomenclature and belong to Malvaceae botanical family. It is called Rudra puspam in Sanskrit and in various other names like Japa, Java, Jasut, Jasum, Joba, Dasinda, Jaswanda, Jasuva, Dasona, Dasala, Somparuthi, Mondaro etc., in various other Indian languages. It is called shoe flower and chinese hibiscus in English.

The stems of the plant contain a fibre of an exceptionally beautiful appearance, white or light cream or yellow, silky and strong. It can be spun into yarn, and made into twines and ropes both by hand and jute mill machineries. It can be woven into hessian, both warp and weft. It can be used for fishing lines and in the manufacture of cardboard and papers. It can be extracted by water retting method and fibre industry based on Jaba Kusum plant is certainly on economic proposition if the plants are economically and systematically cultivated.

The flowers are reported to be eaten raw or pickled in China. They contain thiamine, riboflavin, niacin and ascorbic acid hence may be considered as multi vitamin. Crushed flowers contain an anthocyanin pigment, cyanidin diglucoside. Juice of the flower, crushed with its petals can be used as pH indicator. Flowers are demulcent, emollient, refrigerent, aphrodisiac, and

emmenagogue. Fried in ghee, it is given in menorrhagia. A decoction of flower is effective for bronchial catarrh.

Root of this plant is a substitute for Althaea root. It is demulcent and used for coughs. Its decoction is given in venereal diseases and fever, fresh root juice for gonorrhea and powdered root for menorrhagia.

Jabakusum leaves are demulcent, aperient, anodyne and laxative. A decoction of leaves is used as a lotion in fevers used in far Eastern countries to stimulate expulsion after child birth.

Crushed fresh buds of Jaba Kusum flower if taken in empty stomach cures amoebic dysentery. It is reported that the bud if rubbed on head helps growth of hair. The flowers also contain nectar hence can be useful for growth of beekeeping industry.

This plant is not cultivated as a commercial crop hence its values are not exploited commercially. This can be very much be a part of our afforestation programme so that, it will give us a better environment, natural beauty and its virtues both medicine and fibre.

CHAPTER 38

BHINDI

Bhindi is perhaps one of the most popular cultivated vegetable in India. It is also known as bhinditori, dheros, bhinda, bendekai, and venda in various Indian languages while it is known as ladies finger in English. In botanical nomenclature it is called *Hibiscus esculentus* Linn. belonging to Malvaceae botanical family.

Bhindi is considered to be of African origin. It is found in cultivation throughout India upto an altitude of 1000 metres. It can be grown on any type of soil. Two crops can be raised in a year. The bhindi plant give an extremely nice fibre in a paying manner. The yield is about 100 kgs of fibre per acre and might give additional employment and an additional income to the grower, a point which workers in the cause of village self-sufficiency ought not ignore.

The stems of the plant contain a fibre of an exceptionally beautiful appearance white or light cream or yellow, silky and strong. It can be spun into yarn, and made into twines and ropes. It can be woven into various fabrics using it both as warp and weft. The green stems contain mucilage in plenty. Its extract is a good clarifies for sugarcane juice.

Pods are rich in pectin and mucilage and are a fair source of iron and calcium. Fresh pods are reported to contain Vitamin A, thiamine, reboflavin, ascorbic acid and niacin. A mucilaginous preparation from the pods is used as a plasma replacement.

Leaves employed as emollient poultice. An infusion of the roots is used in syphilis in Malayasia. Infusion of roasted seeds has sudorific properties. Seeds are stimulant cordial and anti spasmodic. The flowers contain two flavond pigments, quercetin and gossypetin.

Whole plant is aromatic, emitting clove - like odour. Leaves

and stems contain iodine hence can be effective preventing goitre. Ripe seed contain an unsaturated edible oil.

This cultivated plant is now being cultivated as a vegetable crop but it has many more virtues which if exploited can give us, medicines, health, fibre and above all self sufficient village economy.

CHAPTER 39

KORA GRASS

A large genus of 700 species widely distributed throughout the world. Sixty species out of them occur in India. Only 5 are important from the point of view of fibres i.e. for mat weaving purposes. A few more are important for medicinal and aromatic purposes. The genus is botanically called *Cyperus* belonging to Cyperaceae botanical family.

The tubers of *Cyperus rotundus* Linn. yield essential oil of antibiotic activity i.e. it arrests growth of *Micrococcus Pyrogenus*. The tubers of *Cyperus Scariosus* R. Br. yield essential oil which would replace patchouli oil. Some more are used as fodder; yet others yield tuberous rhizomes used for medicinal, edible and perfumery purposes.

The most important of those used in the mat industry is *Cyperus Corymbosus* Linn. It is called Korai in Tamil, Kora, Gola methi, Madur Kathi, Mutha, Godu, Tunga, Kadu in other Indian languages. In English it is known as Guinea Rush. It is a glabrous, robust sedge with Culms half a metre to three metres high arising from a creeping woody rhizome. The plant occurs nearly throughout India in marshy situations, particularly in the Eastern and southern parts.

The plant is abundant and grows wild upto an elevation of 2000 metres. It grows on heavy, clayey soils deficient in drainage, and on low-lying swamps and saline lands unfit for any other crop. Its cultivation is simple; but it is limited to parts of West Bengal and Tamil Nadu. It is propagated by suckers or slips with bulbs containing short lengths of culms. They are planted 10 to 12 cms apart. Two to three weedings are given during the first year and in subsequent years, one weeding after each cutting. Once established the plant goes on yielding for 10 to 15 years after which it degenerates.

The plant is ready for harvest in about 10 months after the planting. Culms are cut before the flower heads dry up. The harvested culms obtained in the first year are thick and coarse, and yield is low. Thin culms of good quality are obtained only from later cuttings. From second years onwards two harvests are taken in a year. After harvesting the stems are removed to the drying floor, damaged culms are rejected the flower heads cut off and the culms are sorted into different lengths. They are then dried for two to three hours and split into two or more pieces by a special knife. The split stems are further dried for a day or two and are then stacked.

The market value of the product depends on the quality and lengths of the culms. For mat weaving, the culms may be used as such or after splitting into two and even four, eight or twelve strands. The thinnest strands are used for exceptionally fine mats. The splitting demands considerable patience and skill on the part of the worker. It has not become possible to devise any machine for the purpose as yet.

Three types of mats are made such plain, striped and supertine. The strands are dyed with direct dyes and woven in various designs and patterns. The finest are produced mostly in the state of Tamil Nadu. Plain white ones come from West Bengal.

The weaving of these mats is a very important cottage industry in Japan. The floor of Japanese homes is made invariably from these mats fitted into a framework. The simple beauty of the inside of Japanese homes is not a little to this flooring. For the manufacture of the finest mats, the grass used to be kept in water mixed with bentonite clay for an hour, prior to weaving and then passed between the rollers.

Virtues of the grass described above therefore justify its inclusion in plantation programme.

CHAPTER 40

ATASI

This is one of the most popular cultivated crop around the world. Its oil is commonly known as Linseed used for various purposes to be discussed later while its bast fibre commonly known as Flax. These plants are grown both for the fibre and the seeds but do have medicinal virtues too. Although in many other countries it is cultivated exclusively, in India it is not sown as a pure crop in over 60 per cent of its area. It is sown with other crops, wheat, gram, rapeseed and mustard being the favourites. These appear to be three important reasons for mixed sowing. In the first place it affords an insurance against total crop failure. Secondly, when sown with wheat etc., the latter protected from the depredations of cattle, wild pig, deer etc. as these animals do not relish the plant. The fibres in them get stuck in their throats. Lastly atasi exhausts the soil rapidly, so that interculture with leguminous crops like gram, helps to maintain the fertility of the land. In Karnataka, the states adjoining Karnataka and also in parts of Bihar atasi is sown as border crop to keep the cattle away from the main crops within. It also grows wild in various parts of our country.

The plant is known as *Linum usitatissimum* Linn., in botanical nomenclature belonging to Linaceae botanical family. It is known as Linseed in English, Atasi in Assamese, Bengali, Gujrathi, Hindi, Marathi and Sanskrit and Agasi in Kannada. They are planted close together; as they branch only at the top. Their height is one to one and a half metre. The diameter of the stalk is about half a centimetre.

Even though the yield is poorer than in the main producing countries, the quality of Indian seeds said to be superior, as the oil possesses better properties and the contents of oil in the seed is much higher than elsewhere. For this reason Indian atasi commands a better price in the foreign markets and there is

considerable export trade in the seeds and the oil.

There are about 26 varieties of Atasi in our country. Each variety is different from the other in size, colour and in botanical characteristics. But for the purpose of oil, commercially only the species giving big brown seed and small brown seed have been selected.

Atasi is sown from August to November generally and from September to October generally. The seed is harvested from January to April. The peak season for harvesting is between February and March.

Atasi giving small size seed are grown in north Uttar Pradesh, North Bihar, Madhya Pradesh, Rajasthan and West Bengal while Atasi giving big size seeds are grown in South Uttar Pradesh, Andhra Pradesh and Maharashtra. The oil content in above two varieties are 40 to 42 per cent and 41 to 46 per cent respectively. The second variety are grown the most followed by the first while all other varieties together share 10 per cent of the total cropping.

The Atasi oil is used for various purposes having commercial importance. Properties of Atasi oil is given below :

Properties of atasi oil (Linseed)

Colour	- Yellow
Specific gravity at 15°C	- 0.931 to 0.938
Saponification value	- 189 to 195
Iodine Value	- 170 to 200
Titre	- 15°C
Unsaponifiable matter	- 0.5 to 1.6

Fatty acid composition of atasi oil is given below

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	2.7
Stearic	5.4
Oleic	5.0
Linoleic	48.5
Linolenic	34.1

Atasi oil has quick drying property hence is useful for manufacture of paint, varnish and printing ink. It was also used for oiling cricket bats made of willow wood before used for

batting. It is used for manufacture of soap but yields soft soap since it has more percentage of unsaturated fatty acid. However it can be hydrogenated and used for manufacture of soap appropriately. Fat splitting using sweet water method can yield individual fatty acids which will broaden its uses. It is also used for manufacture of Linoleum. Oil cake can be used either as manure or as cattle feed.

Atasi seed for medicinal use should contain; foreign organic matter $\nless 1.0$ per cent, fixed oil $\nless 25$ per cent, ash $\nless 5$ per cent and water soluble extracts $\nless 15$ per cent. Crude atasi oil contains phosphatides, lecithin and Cephalin upto 1.25 per cent. The protein content of the seed varies between 16 to 31 per cent, principally two globulins e.g. linin and colinin.

Besides linamarin, the cyanogenetic Glucoside, linseed also contains two other Glucosides, Crystalline and non Crystalline. Linamarin is also present in the leaves, stems, roots and flowers which causes death among livestock grazing on atasi plant. Other constituents are phytin, lecithin, and β Carotene forms 22 to 30 per cent of the total corotenoids.

India was never attracted by fibre flax even though as the grower of seed flax we occupy an important place. This is perhaps because of the climatic condition since warmer climate of India tend to make the fibre coarser. Fibre flax adapts itself readily to a wide variety of soil and climatic conditions. The best quality of the fibre and the highest yields are obtained on a moderately rich, sandy, loam, well drained soil in temperate climates, having a fairly cool growing seasons. The temperature is required to be uniformly cool during the growing season. A good rainfall too is essential. The fibres grown in warmer climates tend to become coarser. Even in the most fitted lands, the fibre begins to get coarse and the yield begins to decrease if it is planted continuously. If the best fibre is the aim, the plant should be grown on a piece of land once in six years or so. The ground requires a deep ploughing, through pulverisation and heavy manuring.

There are three stages for harvesting. First when the plant has almost finished flowering and the stalk is still green. Second, when the fruit has set and the bottom leaves turning yellow begin to drop off. Lastly when the seed pods have ripened. The fibre from the first stage is fine and soft but somewhat weak and

the yield is low. That from the third stage is harsh and coarse and difficult to spin, but it is very strong and yield is greater. So, harvesting is usually done in second stage.

The stalks are pulled and bound into bundles, care being taken to have the root ends even. In many areas harvesting is now done with the help of machines. In some areas the plants are cut close to ground but this practice is discouraged as it stains the fibres and the full length does not become available when cut.

The bundles are allowed to remain on the field for a day or so to allow the plants to dry partially. They are then taken to a drying yard. The seeds are removed when the stalks are completely dry. In some areas machines are used to recover the seeds. In others the plants are taken out one by one and are drawn through a comb. Thereafter the plants are stalked away being covered with canvas or straw. This is known as weather proofing.

In India, as told earlier, atasi is cultivated for its oil. Hence seed is considered as principal product of the plant hence everything else is neglected. In most of the cases, during threshing fibre is destroyed which is certainly not desirable. If the seed and straw is separated and both the virtues are utilised we can get both the important products. True, atasi meant for oil yields less and coarser fibre but, this fibre at least can be an important by-product and if utilised can also give utility product generating rural employment.

The bast bundles of fibre can be and are separated from the cellular tissues surrounding them, and also from the woody central portion of the stalks and the dead bark by bacterial action, as in case of many other fibres. But actually retting differs in the matter of details. A number of other operations too become necessary after the retting is completed if the fibre should become clean and spinnable.

Atasi fibre stalk is usually retted either in water or in dew. Water retting is done either in running water by placing the bundles in slow moving river, bogs and dams. It is also alternately retted in a tank where there is an added advantage of maintaining water temperature above 30°C to give superior fibre. If there is no water source dew retting is practised. Fibre obtained after dew retting is usually dark and coarse. The retting becomes complete in 6 to 10 days in stagnant water, 2 to 3

weeks in flowing water and 2 to 3 weeks (depending on climatic condition) in case of dew retting. To get superior fibre tank retting is preferable where in temperature of water is maintained above 30°C and water is changed from time to time to avoid fermentation which affects the fibre quality.

The next processes is the curing. This is nothing more than drying-either in the sun and air or on a mechanical dryer. Natural drying is preferred, since mechanical drying is said to deteriorate the fibres, and is resorted to only in case of unfavourable climatic condition. In Germany, the retted flax is squeezed between rollers to remove the excess moisture. This decreases drying period and is said to produce a fibre of lighter colour and better strength.

The fibres at this stage are still within the stalk surrounded by the bark and encircling the woody core. Only gums and the other binding material become free from them; so the fibres should undergo the scutching process. This is done in various ways. The most popular method is to pass them through fluted rollers which break the woody matter into pieces without harming the regular fibres.

After scutching, the fibres are heckled by hand on coarse steel or wooden hackle pins. The operation removes the shorter fibres and makes them softer. This is also known as combing process.

The fibre thus got, can be spun, for being used for twines or for being woven into bags. This fibre when properly processed, is creamy white in colour varying with the skill and quality of retting and other processes. It is highly lustrous due to the wax it contains. The wax imparts to it better spinning property. The fibre is extremely strong, two to three times stronger than cotton. It is absorbent. It resists the effects of mildew and moisture. Fabrics made from it launder well. It takes all dyes readily. This fibre is also known as linen.

In India after removal of seeds or during removal of seeds the fibre is normally destroyed. Even if the straw remain intact it is normally used as fuel in our villages. On the other hand for certain specific use this fibre is also imported from Europe draining our valuable foreign exchange. When non-degradable synthetics taking over fibre industry, is it not time to plan our fibre industry based on vegetable fibres which are environmentally clean and which are being thrown to gutter.

CHAPTER 41

RADARAMI

Radarami is one of the plant that grows wild all over India and is considered to be highly medicinal. It is called **Kandavakkare** and **Kondanakkera** in other Indian languages. In botanical nomenclature it is called *Ximenia americana* Linn., belonging to **elaeagnaceae** botanical family. It is called **Tallow wood** in English and grows wild in many other tropical countries.

Many of its part are considered medicinal. Particularly its seed pounded in water is given for colic pain. It also grows as a parasite on the roots of other plants.

Radarami seed contains high percentage of oil which can be utilised for various purposes. Its Kernal gives **49 per cent** oil. The properties of Radarami oil is given below :

Properties of Radarami oil

Specific gravity at 20°C	-	0.9262
Refractive index at 20°C	-	1.4710
Saponification value	-	169.2
Iodine value	-	82.5
Acid Value	-	2.3
Unsaponifiable matter	-	1.7%

This oil apart from various fatty acids also contain **1.5 per cent** resin. Hence Radarami soap is capable of producing sufficient foam without adding any foam booster. Fatty acid composition of Radarami oil is given below :

<i>Fatty acid</i>	<i>Percentage</i>
Stearic	1.2
Cerotic	15.2
Ximenic	14.6
Oleic	60.8
Linoleic	6.7

However, soap produced out of Radarani oil is soft. Hence, it has to be used at low proportion or the oil has to be hydrogenated before saponified. Oil can be splitted by sweet water method to give us individual fatty acids which can be used for various purposes like soap making pharmaceutical or mineral dressing. In addition it will yield glycerine which also do have various use.

Radarani grows wild in India hence its virtues are not utilised properly. A thought may be given for its appropriate use.

CHAPTER 42

MUSTARD

Mustard is one of the most important edible oil crop of India cultivated in different proportions in Rajasthan, Uttar Pradesh, Bihar, West Bengal, Orissa, Assam, Madhya Pradesh, Gujarat, Maharashtra, Haryana and Punjab. Although it is basically a oil crop, it is also used in various purposes. In India we produce three types of mustard such as white variety, black variety and brown variety. According to botanical nomenclature their names are *Brassica alba*, *Brassica nigra* and *Brassica juncea* respectively all belonging to *Cruciferae* botanical family.

Mustard leaves contains essential oil. It can be a good cattle feed and may be utilised for green manuring. Tender leaves are edible not only for its taste but also contains vitamins and minerals notably Vitamin A. It also contains amino acids. Infact *Sarsho-ka-sag* is a popular dish in Punjab.

Its small beautiful yellow flowers appear towards the end of winter and continues during spring. It has the nectar that gives sufficient honey. Mustard honey is light yellow in colour, having beautiful flavour and tasty having good market demand. Problem remains being the honey contains more sucrose than fructose or glucose hence solidifies during cold season. Flower in general contains essential oil. Pollens yields vitamins and minerals.

Mustard in general known as *Sorswo* or *Rai* in Hindi, *Sorisha* in Bengali, *Sorha* in Assamese, *Sorisha* in Oriya, *Kali rai* in Gujarathi, *Mohori* in Marathi, and *Sasive* in Kannada. But these names usually refers to its seed or oil. In Hindi this oil is often referred to as *Mitha tel*. This plant yields water soluble amino acids like *Ninhydrine* etc, which can easily be extracted.

Seed apart from yielding oil itself is edible. It is often used with various vegetarian and non-vegetarian preparation to add

taste. Seed paste mixed with vinegar is taken raw with various fried preparations. A preparation called Kasundi is prepared out of its seeds used as pickle in West Bengal and Bangladesh. The seed contains essential volatile oil which has popularity throughout North India and because of this reason this oil remained as most popular edible oil in Hindi belt, West Bengal, Assam and Orissa. Oil extracted out of ghani is more popular since in this case essential volatile oil remains intact. Volatile oil in white variety is increased by mixing with black and brown.

Properties and composition of three types of mustard oil varies slightly but difference is negligible so also its end use. Properties of *Brassica nigra* variety is given below :

Properties of nigra variety oil

Specific gravity at 15°C	- 0.917 to 0.922
Saponification value	- 176 to 184
Iodine value	- 114 to 124
Titre	- 6.8°C

Fatty acid composition of black mustard oil.

<i>Fatty acid</i>	<i>Per cent</i>
Palmitic	2.0
Stearic	2.0
Oleic	24.5
Linoleic	19.5
Linolenic	2.0
Erucic	50.5

This edible oil is so popular it is even consumed raw. The seed contains 31 to 33 per cent oil. This oil can also be used for manufacture of soap. The oil is very good as a massage oil and prevents cold during winter if massaged. It is also good as a massage oil for children as it helps growth of skin. However, this oil has been adulterated upto maximum extent due to its strong odour which covers up odour of adulterated oil. Due to high percentage of unsaturated fat it is considered to be healthier edible oil than ghee or coconut oil.

This is undoubtedly a popular cultivated crop in India but its other virtues need to be exploited and for which there is need for content R & D.

CHAPTER 43

SOYA BEAN

Soya bean is one of the most important food plant, considered to be contribution of Mongolian race to the human population of the world. Known as *Soja japonica* Linn., and *Glycine max* merr according to botanical nomenclature belonging to Leguminosae family was considered as one of the sacred plants by the Chinese and Japanese. Native of China, Japan, Mongolia, Indonesia and Far eastern countries and North Eastern India notably Nagaland and Arunachal Pradesh has grown as one of the most popular cultivated crop all over the world primarily as a source of edible oil. It is now being raised in Madhya Pradesh and hill districts of Uttar Pradesh.

Soya beans are the world's largest single source of edible fats and oils. This growth in importance reflects a continuing expansion of Soya bean production in the U.S.A., where it has increased approximately ten fold since 1900. Soya bean seed gives about 15 to 20 per cent oil which oil has to be extracted by solvent extraction. Properties of Soya bean oil is given below.

Properties of Soya bean oil

Colour	- brown mixed with yellow
Consistency	- liquid
Specific gravity at 15°C	- 0.922 to 0.925
Saponification value	- 190 to 194
Iodine value	- 121 to 140
Titre	- 21 to 25°C
Unsataponifiable matter	- 0.3 to 0.6

Fatty acid composition of Soya bean oil is given below :

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	7.2
Stearic	4.2
Arachidic	0.5
Lignoceric	0.1
Oleic	32.3
Linoleic	52.0
Linolenic	2.2

The oil is basically unsaturated hence is healthy. Due to its liquidity it has greater capability to carry dissolved vitamins to the tissues. This oil is good for manufacture of soap as well as for manufacture of paints and varnish. As edible oil it is used as part of margarine, shortening, salad and cooking oils. However soap produced is very soft.

Soya beans not only contain 40 per cent protein but also protein of high quality. We have, in our country have already started marketing processed Soya beans devoid of its odour, for acceptability. Soya bean infact is richer in protein than even our non-vegetarian foods of animal origin. While giving us our required protein, it may be mentioned that it does not have adverse qualities of animal protein and its easier to digest. From its seed artificial milk is extracted which has all natural nutrients of cows or buffalo milk except fat. Therefore it is more acceptable even for children, old and patients. This milk, rich in protein also can be used for manufacture of cheese, curd or any other prepared food that is considered as milk food.

The Soya bean leaves may be used as a substitute for Coffee or tea. Mature bean seeds, like any other pulses contain small amount of cortene, fair quantity of vitamin B complex and a little Vitamin C. Germinated Soya bean becomes a rich source of Vitamin C. The presence of Vitamins D, E and K has been reported. It is a good source of β -amylase, urcase, and lipoxidase. The last one in the form of Soya flour extract is used as a bleaching agent for bread flour. It also contains variety of pigments such as Carotenoids, isoflavone glycosides, anthocyanins and Chlorophyl.

In brief we may say that Soya bean is a plant given by nature as blessings to mankind and we must encourage its propagation. Rightly, people of China and Japan considers it as a sacred plant.

CHAPTER 44

KARAVI

Karavi is one of the popular garden plant famous for its aromatic flower. It also grows wild both in forest and elsewhere. It is also known as Pila kaner, Kolka phul, ashvaka, pachaiyalari, pachchganeru and pachcharali in various Indian languages. In botanical nomenclature there are two types of Karavi such as *Thevetia peruviana* Pers and *Thevetia nerifolia* Juss, belonging to same genus and both belonging to Apocynaceae botanical family. The two genus varies slightly in their composition, colour of the flower etc.

All parts of plant gives a cardiotoxic principle thevetin in different proportions. New minor digitalis poisons in the grains of *nerifolia* such as thevetofoline, and thevetenine are reported. Seeds are highly medicinal. An heteroside is reported in the seeds. Besides fatty oil, Kernal gives a water soluble glycoside called thevetin which is a cardiotoxic principle. Defatted Kernals, on subjection to enzymic action give four glycosides such as cerberine, nerifolin, peruvoside and ruvoside.

Traditionally the plant is used for combating various diseases. It is believed that the plant is useful for urethral diseases, worms, leucoderma, piles, bronchitis, skin diseases, rheumatism, heart diseases, fever and itching.

Seed Kernal gives a semi saturated fat. Seed contains 57 per cent fat. Properties of Karavi oil is given below.

Properties of Karavi Oil

Specific gravity at 15°C	- 0.903
Refractive index at 40°C	- 1.4599
Saponification vlaue	- 194.1
Iodine value	- 76
Unsataponifiable matter	- 1.4%

Fatty acid composition of Karavi fat is given below :

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	17.1
Stearic	11.8
Arachidic	0.4
Oleic	64.3
Linoleic	6.3

This fat is obviously suitable for manufacture of soap due to high saponification value. But it has to be used either in limited proportion or has to be hydrogenated before saponified to maintain physical consistency of the soap. Fat can be splitted by sweet water method to yield individual fatty acids and Glycerol hence can enhance its uses.

Oil cake can be used for various purposes. Four Glycosides can be isolated after enzymic action on defatted cake as mentioned before. Thevetin being water soluble can also be isolated easily, at low cost. Above all oil cake also can be a good manure and can be utilised for manufacture of adhesives.

As told earlier, Karavi is basically popular for its flora. Karavi flowers do have nectar hence there is possibility of growth of beekeeping industry based on this flora. Karavi flower is also highly medicinal.

This plant is not considered as part of plantation programme except in a scattered manner as garden plant. Hence its full virtues can not be utilised. It can become a useful plant if it is planted in concentrated manner.

CHAPTER 45

OLIVE

Olive is basically of European origin and is cultivated only few decades back in Karnataka and Andhra Pradesh with concentration in coonoor. It originates both side of Mediterranean coast but has become popular crop in California, Australia, South Africa and East Africa later more because of its Biblical connections than virtues. It has spread with the spread of Christianity. Olive is considered sacred by the sons of Judaism. Olive leaf symbolises peace and happiness as the Biblical story of great flood and after describes the sight of Olive leaf brought happiness.

Commonly known as olive every where except in Kannada, which calls this plant as Jeeva Vriksha. In botanical nomenclature it is called *Olea Europaea* Linn., belonging to Oleaceae botanical family. Entire plant is considered to be useful in many ways.

Leaves contain a kind of choline compound which can be extracted by water and has blood pressure lowering capacity. Entire plant in different proportion yields unsaturated lactone, selenolids and Oleuropic acid, all of them if isolated do have many chemical and pharmaceutical use.

Most important and popular product of this plant however is oil. Seed and Kernel yields 25 and 28 per cent of oil respectively. Besides seed, fruit, pulp and skin also yields oil Properties of olive oil is given below :

Properties of Olive Oil

Colour	- Light yellow
Consistency	- Liquid
Specific gravity at 25°C	- 0.925 to 0.913

Saponification value	- 190.6 to 193.6
Iodine Value	- 83.7 to 86
Titre	- 22.5°C
Unsaponifiable matter	- 0.8 to 1.1

Fatty acid composition of Olive oil is given below

<i>Fatty acid</i>	<i>Per cent</i>
Myristic	traces
Palmitic	9.2
Stearic	2.0
Arachidic	0.2
Oleic	83.2
Linoleic	3.9

Olive oil from Italy is considered to be the best. It has light golden yellow colour and has better in other quality. Indian Olive oil usually has a little darker colour with greenish tinge. Olive oil is excellent edible oil. It has more unsaturated fat and its fluidity helps in carrying nutrients to the tissues easily. Due to scarcity and high price it is now being used more as a saled oil. It has cooling effect hence keeps body cool. As massage oil it is considered to be the best. It keeps the skin soft and due to coolant effect it prevents many skin eruptions. Commercial Olive Oil with Calcium and Vitamin A is considered to be best massage oil for children. Oil cake is a good cattle feed and manure. If processed properly it can also be edible. Olive flora has nectar too. Hence beekeeping can be planned around the olive field.

This plant yet to be naturalised in India due to climatic condition. Wherever possible plantation may be encouraged.

CHAPTER 46

MAIZE

Maize, though believed to be native of U.S.A. and Argentina, is actually also was a traditional cultivated plant of India since memory lasts. Its germ or grains usually burnt in naked fire and taken with salt, lemon and oil. Commonly known as Corn in English and also as Makai in Hindi, Bhutta in Bengali, Makka in Oriya and Masukira Joloda yenne in Kannada. In botanical nomenclature its called *Zea mays* Linn., belonging to Gramineae botanical family. In many places in India, the germs or seeds are ground into flour and breads are prepared out of it. Corn flakes, sold in various brand names is one of the popular processed food out of maize. Sweets are also prepared out of Corn flour. Pop corns are also popular dish in urban India. Among the tribals maize is often fermented with rice to prepare popular beer.

The popularity and increasing popularity of maize as food is due its taste. However more than taste it is recommended as food by our physicians due to nutrition. The grains contains, starch, protein, fat, carbohydrate, vitamins and minerals hence is a complete food for all ages. Maize is industrially utilised for manufacture of edible starch and glucose.

Stigmate yield a fat containing sitosterol and a small amount of betaine certain carotenoides are reported in the yellow corn. Corn or Maize oil is employed in heart diseases both as part of food and as medicine. Ingestion of the oil (2 oz. per day) and a diet low in animal fat lower serum Cholesterol as long term measure. Due to low unsaturation this oil is acceptable as edible for heart patients and patients having high serum Cholesterol.

Maize germs yields 50 per cent oil. The physical properties of maize oil is given below :

Properties of maize oil

Colour	- Golden yellow
Consistency	- Liquid
Specific gravity at 15°C	- 0.921 to 0.927
Saponification value	- 186 to 193
Iodine Value	- 15 to 130°C
Titre	- 15 to 19°C
Unsaponifiable matter	- 1.5 to 3%

Fatty acid composition of maize oil is as follows :

<i>Fatty acid</i>	<i>Per cent</i>
Palmitic	7.3
Stearic	3.3
Linoleic	39.1
Lignoceric	0.2
Arachidic	0.4

In India maize oil is produced as by product of starch industry. It is yet to be popular as a edible oil inspite of being so good for health, basically since its quality is not maintained since it is a secondary product. It can also be used for manufacture of soap upto limited extent besides in paints and varnish industry.

Maize is a cultivated as well as a wild crop in India. But its virtues need to be exploited further.

CHAPTER 47

AMRIT DARU

Popularly known in English as Brazil wood tree or Pockwood tree, is believed to be native of tropical America but found all over India. Fact that it is often referred in ancient Sanskrit texts as Amrit daru, Lohkasht, Jivdas and Bridh Mitra, we may assume that it was traditionally grown in India since ancient days. It is known as Chobehyat in Hindi and Loh - lakkar in Marathi. In botanical nomenclature it is known as *Guaiacum officinale* Linn. belonging to *Zygophyllaceae* botanical family. As name in Sanskrit expresses it is highly medicinal or the wood that conquer's death.

Infect the gum that its wood yield has all the medicinal quality. The wood yields *Guaiacum* or *Guaiaie* resin obtained either as a natural exudation from the tree or by burning logs of wood at one end after making incisions in the middle when the resin flows out and is collected. Quite often the wood in chips or sawdust form is boiled in brine or sea water when the resin melts and is collected from the surface. This gum is a mild laxative and is used in the treatment of chronic rheumatism and gout. In the form of lozenges it is employed in the treatment of tonsillitis and pharyngitis with rheumatism.

Used to prevent rancidity and loss of flavour in preserved foods, is antioxidant for lard. It is used in the form of tincture for the detection of blood stains and for testing presence of Cyanogenetic glycoside

The stem bark yields another resin distinct from but analogous to that of wood. It is acrid and stimulant and used in tinctures and Plummers pills.

It is cultivated but in a scattered manner. Often the trees are felled to extract resin which has good market value. Attempt should be made to go for scientific cultivation and extraction without felling the trees so that we can have sustainable growth.

CHAPTER 48

SAN HEMP

One of the popular shrub rising upto a height of one metre to three metres, famous for yielding fibre for utility use is San hemp is commonly cultivated crop either for fibre or for green manure in rotation with grain or cash crops. It is also a good fodder crop. Known as San hemp in English, Sana in Sanskrit, Saunai in Hindi, Shonpat, Shon or Shore Sun in Bengali, Tag in Marathi, Saunappa in Tamil, Janumu in Telugu, Sanabu in Kannada and Wuckoo nar in Malayalam is cultivated throughout India. In botanical nomenclature it is known as *Crotalaria juncea* Linn., belonging to Leguminosae botanical family. Other plants of same genus are *Crotalaria alata* Linn., *Crotalaria anagyroides*, *Crotalaria burlivia*, *Crotalaria laburnifolia*, *Crotalaria medicaginea*, *Crotalaria servia*, *Crotalaria mucronata* and *Crotalaria spectabilis*, all of them more or less are called in the similar local names and all of them are popular as fibre yielding plants *Crotalaria anagyroides* is a native of Venezuela but was introduced in India as a shade shrub for tea and coffee plantations.

However, the medicinal and other virtues of these plants were never exploited. Seeds of *anagyroides* contain L-methylene pyrrolizidine and senecionine which has many pharmaceutical use. Seed extract of *juncea* variety gives corchorin, a bitter principle. Seeds of *medicaginea* variety gives linoleic acid rich oil which has therapeutic value in preventing atherosclerosis. Its unsaponifiables yields, pentatricontane, triacontanol and β -sitosterol all of them have therapeutic value in pharmaceuticals. The fat also yields myristic, behenic and oleic acids and is basically unsaturated fat good for soap making and pharmaceutical use. Seeds of *mucronata* variety yields an important alkaloid mucronalin. In case of *spectabilis* variety

toxic alkaloids monocrotaline is isolated from all parts. Steroidal saponins are absent in roots, leaves and flowering tops.

The juncia variety is supposed to be best fibre plant out of the lot. It is indigenous to India. It has been grown in India, Pakistan and Bangladesh from prehistoric times. Indian subcontinent account for more than 99 per cent of the world's production of San hemp fibre. Attempts are in progress to improve the stains. A variety known as Jubbulpore gives a fibre which is superior both in strength and durability. Kanpur 12 gives a high yield of a superior fibre.

San hemp is cultivated nearly throughout India. Uttar Pradesh has about 40 per cent of the total acreage of India. Madhya Pradesh has about 10 per cent. The other States have less than 10 per cent but together account for the remaining 50 per cent. About 8 per cent of the production of Andhra Pradesh and Tamil Nadu is used for manuring and fodder purposes. Anagyroides variety are cultivated in West Bengal, Assam and Nilgiri hills purely as shade plant but its virtues are not exploited.

San hemp grows on almost any soil, but best result are obtained on a light loamy, moderately rich, well drained soil for fibre development. In clayey and low lying soils, it makes a vigorous growth, but fibre obtained is coarse and the yield is poor. Water logging is definitely harmful for its growth. The preparation of the land for the crop is the same as for jute.

It is grown generally as a single crop when required for fibre or seed. It is sown about the commencement of South West monsoon in June and harvested before the end of October. In certain parts of West Bengal and Maharashtra it is also sown as a rabi crop in September or October or harvested in February or March. In the south it is grown both as rabi and kharif crop.

The seeds are sown broadcast. Occasionally they are also drilled. To ensure a crop without much branching they are sown thick. If the germination is satisfactory no further culture is required until the crop is ready for harvesting.

The crop takes 4 to 4½ months to mature fully. But if it is intended for fibre it has got to be harvested earlier. Opinions

vary as to the stage of maturity for harvesting. The state when the strength, colour and lustre develop varies according to climatic and other factors. In Uttar Pradesh and Madhya Pradesh harvesting at pod formation has given good results. In Andhra Pradesh and Tamil Nadu harvesting at pre-flower or full bloom stage was found to be the best. In Bihar the green pod stage was found to be the best for the early varieties and the pre-flowering stage for the late varieties. Some prefer the late mature stage as it would also enable the gathering of the seeds.

For obtaining the fibres, either the entire plant is pulled out or the stalks are cut close to the ground. In certain parts, the tops are chopped off soon after the harvesting for use as fodder. The harvested plants are then tied into bundles of 50 to 100 stalks. They are thereafter left on the ground for 2 to 3 days for the leaves to wither and drop off. In some areas the stems are retted only after drying. In West Bengal and Bihar retting is done after harvesting but pre-drying supposed to yield a better fibre. Retting is done more or less similarly as in case of jute. It helps to separate the fibres from the binding substances which keep them together in the tissues. The method and duration of retting differ from place to place depending on the temperature of the retting water and the stage at which the plant is harvested. Retting should be done in clear, stagnant or slow flowing water. Where either is not available the stalks are dried and retted in stored water. If it is retted along with root, retting becomes uneven. For uniform retting therefore either the roots are chopped off or broken off. If the retting is satisfactory, the fibres peel off smoothly.

After stripping, the fibre is washed by lashing in water and dried in sun. It is then twisted and folded for being marketed. The quality of the fibre is judged by the length, fineness, colour, uniformity and extent of associated extraneous matter. The quality, besides other factors is also influenced by retting. Many complaints such as lack of uniformity, presence of mud, sticks and matted matters can be eliminated if more attention is given to retting.

San hemp is light in colour, possesses greater tensile strength and is more durable under exposure than jute. For these purposes it is more popular than jute, and gets a higher price in foreign

markets. Fact that demand for seed of juncia variety in foreign market is increasing, it appears that attempts have began to be made to cultivate the plants in them.

San hemp is essentially a cordage fibre. Considerable quantities are used in making unsized twines used for fishing nets, cot stringing, matting and cordage. In some places coarse canvas bags are made on a cottage industry basis.

About 40 per cent of the San hemp produced in India is exported to foreign countries where it is extremely popular. In U.K. and Belgium it is employed in the manufacture of twines, cords, matting, sacking, soles of shoes, tarpaulins and even marine cordage. Cordage from Indian San hemp fibre is extremely resistant to sea water. It is a good raw material for manufacture of wrapping paper. In U.S.A tissue paper needed for cigarette industry also being manufactured from San hemp fibre. The tow or short ends obtained in the combing of the fibres are used in chaulking the seams of the ships. The fibre is also used for manufacture of rugs, carpets, webbing, fire hoses, table and bed linens.

San hemp stalks are used as a cattle fodder. They contain mineral matter to the extent of 6 per cent and carbohydrates to the extent of 30 per cent. The foliage too is a valuable cattle feed. The seeds and pods are known to be toxic. Hence they are to be separated before the stems and leaves are fed to the cattle. The seed oil is non-edible but a good raw material for soap making. The seed proteins are used for manufacture of plywood adhesives.

San hemp is regarded as a manure crop par excellence since it is leguminous, it produces an abundance of root nodules, and it grows very quickly. It is hardy and drought resistant. When quickly grown it smothers out all the weeds. When grown in rotation with such exacting crops as Sugarcane, tobacco, rice, potato and jute they benefit considerably by the nitrogen and the humus added to the soil. Even the resistant weeds like the Kans grass can be smothered by the San hemp. It is gaining favour in recent days as a green manure and cover crop in tea, coffee, coconut and rubber estates too for all these reasons. A good crop of San hemp yields about 9000 to 14000 kgs of organic matter per

acre, which on decomposition adds 30 to 50 kgs of nitrogen besides potash and phosphorus in substantial quantities.

The fibre accounts for only 8 per cent of the entire plant system. In addition to all above it consists of a aqueous extract to the extent of 28 per cent, besides fats, waxes, cellulose and pectins which are neither helpful as manure nor for fibre but has much greater and valuable uses. Hence this plant is not merely a fibre plant or a manure plant but a system of industrial growth if all its virtues are exploited properly.

CHAPTER 49

SWET JABA

Swet jaba believed to be indigenous of China is being cultivated in India as a garden plant for its beautiful flower. It is planted throughout India. While it is called Swet jaba in Bengali, Rose of sharon in English, it is also known as Gurhal in Hindi, Oriya and Punjabi (Gurumukhi). In botanical nomenclature it is called *Hibiscus syriacus* Linn and belong to Malvaceae botanical family. Except as a fancy plant its virtues are not exploited in India.

Like other plants of Hibiscus genus, this plant is also a fibre yielding plant. The stems of this garden plant like its brothers and cousins growing cultivated or uncultivated give a fibre of same nature as the case of lady's finger fibres and can be extracted and processed same way. The fibre that it yields is an exceptionally beautiful in appearance, white or light cream or yellow, silky, strong and pliant. It can be spun into yarn, and made into twines and ropes both by hand and machines. It can be woven hessian, both warp and waft. It can be used for fishing lines and in the manufacture of cardboard and paper. Fibre is extracted usually by retting method like roselle or kenaf.

Leaves of this plant is used as a substitute for tea in China. Its extract is believed to be stimulant and stomachic.

Petals of the flowers believed to cure amoebic dysentery. Decoction of the flower is diuretic and is used for itch and other skin diseases in Vietnam. Flowers also contain a number of vitamins and minerals particularly Vitamin B complex which helps in curing stomach disorders. Flowers also have nectar, hence beekeeping industry can be planned based on this flora.

Bark and root are mucilaginous demulcent and antifebrile. They are good for curing or relieving diarrhoea, dysentery and dysmenorrhoea.

Seeds are used in headache and colds. Seed oil if extracted can be used for various purposes. Mixed with pig marrow seeds are applied on ulcers.

Virtues of this plant is yet to be reviewed in India. It can become an effective commercial plant if utilised properly in addition to adding to our natural beauty and environment.

CHAPTER 50

APPLE

An apple a day keeps doctors away. It is a common belief all around the globe. It is generally believed that this plant is not of Indian origin but was first cultivated in India in Himachal Pradesh being brought from Europe. But it is said some varieties of apples grew wild in some Himalayan states. In English it is known as cultivated apple, while it is called Kushu in Ladakh, in Bengali it is called apel while in Hindi and Punjabi is known as Sev. In botanical nomenclature various species like *Malus pulhima* Mills, *Malus Sylvestris* and *Pyrus malus* Linn., etc are available all belonging to Rosaceae family. This plant is commonly cultivated at Srinagar, Kulgam, Uttarmachipura, Udhampur and Kishtwar in Jammu and Kashmir, Almora, Nainital and Garhwal districts of Uttar Pradesh, Kulu valley and Simla hills of Himachal Pradesh, and Nilgiri hills of Tamil Nadu.

As the proverb says the fruit itself is nutritious. The Vitamins present in fresh apples are thiamine, riboflavin, niacin and ascorbic acid. Malic acid constitutes the principal acid i.e. 0.95 per cent, besides citric, lactic and succinic acids. This fruit is also a valuable antiscorbutic fruit, rich in pectin and useful in diarrhoea.

Leaves contain an antibacterial substance phloretin (yield 2.4%). It inhibits the growth of a number of Gram - positive and Gram - negative bacteria in as low a concentration as 30 ppm.

Bark of apple trees, particularly root bark is anthelmintic, refrigerant and hypnotic. Infusion of the bark is given in intermittent remittent and billious fever.

Flower yields essential oil which can be used as flavours for food. It has nectar hence yields honey. Beekeeping industry can therefore grow well. Infact apple honey is sold in Ranikhet and Almora.

Sugars constitutes 80 per cent of the total carbohydrates of ripe fruits. Fructose is the principal sugar followed by glucose and sucrose. Their yield being 60 per cent, 25 per cent and 15 per cent respectively. The pectin content of edible portion varies from 0.14 to 0.96 per cent (as calcium pectate). Asparagine accounts for 50 per cent of the non protein nitrogen present in mature fruits

Its wood is a good timber and can be used for manufacture of cheap furnitures. Bark yield a type of fibre whose commercial value yet to be tried. At the centre of the fruit there are a number of dark brown seeds. Seeds when crushed yields fatty oil, but much study has not been carried out about this oil. It can be useful for soap making or may be edible if there is absence of toxic substances.

Boiled fruit pulp is considered to be medicinal, particularly for stomach diseases. Apple juice is considered to be a healthy beverage. When cooked with mutton it helps making the cooked mutton softer. There are many more virtues which are yet to be exploited

CHAPTER 51

BAHEDA

Baheda is a wild grown plant grows usually in the forest areas of medium altitude. It is a evergreen plant. It is also known as Behada, Akkam, Tandra, Tusnam, Tandi, and Hulluch in various other Indian languages. In botanical nomenclature it is called *Terminalia belerica* Roxb., belonging to combretaceae botanical family.

Fruit of this plant, particularly its hard pulp is considered to be medicinal according to traditional herbal system. It is good for cough and cold, throat infections and for stomach diseases. The fruit contains ellagic acid. It is also considered as mild laxative. Besides medicinal virtues baheda fruit is also used for vegetable tanning of leather and dyes needed for textile industry.

It contains a single seed. Seed coat contains gallic acid hence can be used for dye indutry and pharmaceuticals. Seed contain 38.6 per cent oil. Properties of beheda oil is given below.

Properties of baheda oil

Specific gravity at 30°C	- 0.9108 to 0.9193
Saponification value	- 198.8
Iodine value	- 89.1
Acid value	- 2.4 to 4
Acetyle value	- 18.7
Hehner value	- 94.8

Fatty acid composition of baheda oil is given below :

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	11.8
Stearic	16.0
Oleic	43.21
Linoleic	28.99

The oil can be excellent raw material for soap but should be used at lower proportion due to low iodine value. However it can be used at higher proportion if hydrogenated. It can be a good lubricant. Individual fatty acids can be separated by sweet water method, and if so its use can be further expanded. It can also be a good massage oil.

Heart wood and bark contains ellagic acid, hence can be used in pharmaceutical and chemical industry. Use of its bark fibre for rope making in cottage scale may be thought off.

Felling of this plant should be avoided. The plant if not anything else assures us better health and oil for industry besides of course the traditional use in tanning the leather.

CHAPTER 52

SAJANA

It is a popular tree growing all over India and other tropical countries. The fruit is a popular vegetable every where. The tree is a large evergreen tree growing even upto 6 to 7 metres. It is known commonly as drum stick in English due to shape of its fruit, Sojan in Bengali, Sajana in Assamese, Oriya a part of Bihar besides Senga Sugri, Murungai, Shevga, Nuggikai etc., in various other Indian languages. There are two or three species in the same genus, all are known by same name. All of them belong to Moringaceae botanical family. Common species found in India are *Moringa Oleifera* Lam. and *Moringa pterygosperma* Gaertn.

This large tree has very small leaves. The leaves are believed to cure skin irritation caused due to hairy catnip so common before and after rainy seasons in tropics. Tender leaves believed to cure harpiss. Leaves are also anthelmintic and effective on eye diseases. Leaves with flowers taken as part of vegetables and if taken regularly prevents night blindness due to presence of Vitamin A.

Bark yields a base, moringine which is identical with benzylamine. It also contain an antibiotic principle pterygospermin. Above all both the root and bark are analgesic and laxative. Stem - bark contains β - sitosterol.

Flowers are white and small appears in bunches. It is traditionally used in inflammation of tumours. It contains essential oil, vitamins (notably vitamin A) and mineral. Flowers are edible in many part of our country. Flowers do have nectar and hence yield honey. Sajana honey is popular due its sweet aroma but it solidifies during winter since out of total sugar, percentage of sucrose is higher than fructose and glucose. The honey has lighter colour and do have market demand specially

during hotter seasons.

Fruit appears normally during summer and is a popular vegetable. It resembles a stick of about 30 cm. long with circular cross section of half a centimeter to one centimeter dia varying from species to species, and having tapered pointed end. Perhaps due to this shape, the plant is known as drum stick. The fruits are always dark green in colour. The pulp and bean seeds are covered by fibrous cover. This fibre is so strong and undigestable that it never becomes softer even after prolonged boiling. As vegetable, this is cooked after cutting into pieces along with other vegetables. Actually however, the pulp and the seeds are consumed while the fibrous portion is thrown away after chewing. No thoughts are yet given to utilise this strong fibre as rope or any other purposes after separating the pulp and seeds. The pulp of this fruit is believed to be nutritious and controls sugar of human body if consumed. This vegetable is as popular that we can't imagine 'Sambhar' all over South India without pieces of Sajana nor can we imagine the side dishes in Bengal, Bihar, Orissa and Assam made without this fruit.

Sajana seed yields about 21 to 24 per cent unsaturated oil. The properties of Sajana seed oil are given below.

Properties of Sajana Seed oil

Specific gravity at 15°C	- 0.913
Refractive index at 20°C	- 1.4638
Saponification value	- 186
Iodine value	- 67.7
Acid value	- 2.3
Unsataponifiable matter	- 3.7%

Sajana seed oil yields a number of fatty acids like any other vegetable oil. Fatty acid composition of Sajana seed oil is given below.

<i>Fatty acid</i>	<i>Percentage</i>
Myristic	7.3
Palmitic	4.2

Oleic	65.8
Stearic	10.8
Beheric	8.9
Lignoceric	3.0

This oil is believed to be extremely good lubricant. It can also be used as raw material for soap upto limited extent. Although not tried so far, the oil can also be tried as edible oil. By splitting the fat we can get fatty acids and glycerol hence the use of this oil can be further expanded. It is also a good massage oil.

The plant is therefore a very useful plant for our sustainable growth. Let us encourage its plantation and given thought of its further utilisation

CHAPTER 53

KODIPULLU

Kodipullu is an important aromatic plant of India which has its origin in Kerala. Known as Kodipullu in Malayalam but commonly known as Malabar lemongrass all around the globe. It has wild growth all over Kerala particularly around Malabar area but as the demand of its oil grew, it became a cultivated crop not only in Kerala but also elsewhere. As per botanical nomenclature this grass is known as *Cymbopogon Flexuosus* belonging to Gramineae botanical family.

Kodipullu or lemon grass is cultivated in hill slopes as a rainfed crop. It requires a warm tropical climate. It does not thrive in marshy land. Warmth and sunshine conduce to development of oil in the plant. The grass grows best on well drained sandy loam. The soil need not be very fertile. There is a research station at Odakkali in Kerala where research on various aspects of lemon grass is being carried out.

Transplanted crop is found to be superior to directly sown crop in respect of yield of grass, oil and citral content in the oil. The seeds are sown by hand in a well prepared bed towards the end of April or early May. 10 kg of seeds sown in an area of 25 cents give enough seedlings for one hectare land. The plants are transplanted in the main field on raised beds having 75 to 80 cms, during the months of June. The ridges are made along the contours in slopy land. Two or three slips are planted per hole with a spacing 15 to 20 cms. Four to five rows can be planted on one bed. The top of the leaves are cut before planting.

Throughout the life span, the crop should be weeded out depending upon the weed growth in the land and earthing up should be done at least once in a year, obviously after monsoon. The crop is usually manured with organised manure. Application of spent leaf material from distillation plant in the

form of compost mixed with wood ash is beneficial. It shall provide sufficient Nitrogen and Potash needed by the crop.

The time of cutting exerts a considerable influence upon yield and quality of oil. Young and tender grass if harvested yields an oil abnormally low aldehyde content and of poor solubility. In general the yield of oil is abnormally lower in the months of heavy rains than in the dry months.

The first cutting is done about 90 days after planting and the subsequent cuttings are taken at an interval of 45 to 50 days. The grass is cut 10 cms above the ground. Five to Six cuttings can be taken in a year subject to climatic conditions. Depending on the soil and climatic conditions the crop can be retained in the field for 5 to 6 years. The yield of oil reaches the maximum in the third or fourth year after which it decreases progressively.

The cut grass is stillcd in copper stills with water or steam to extract oil. The time required for steam distillation of one charge is 2 to 3 hours including for charging the stills and for discharging the plant materials. The yield of oil fluctuates greatly with the season and the condition of plant materials, its moisture content and the age of the grass. Young plants and young shoots should not be used for distillation. They may yield oil more than the older plants but the oil will be deficient in citral. Four charges can be distilled in a day if the steam boiler is used.

The oil is used in perfumery, soaps and cosmetics and as mosquito repellent. The oil is a principal source of citral from which ionone is derived. β -Ionone is the starting material for vitamin A synthesis. Yield of essential oil on an average is 0.4 per cent. This oil contains geranic acid, methylheptenone, citral, p-Cymene, myrcene and geranyl salicylate.

The spent grass after distillation is now being used either to prepare compost or occasionally as cattle-feed. But basically it is a cellulosic grass and can be an excellent raw material for manufacture of paper and hard board. Although, it has fibre but strength of this fibre is extremely poor.

This plant is traditionally being cultivated all along Malabar coast. But during recent years, it was successfully cultivated in Phibani and Kalahandi districts of Orissa, Nagaland and Mizoram. A number of distillation plants are running successfully in Nagaland particularly in Kohima and Mokokchung districts. It is an excellent crop for low fertile hilly land with a tropical climate.

CHAPTER 54

ROHISA

This is another variety of grass of the same genus and family of Kodipullu yielding essential oil. It is known as Rohisa in Sanskrit, Gandh bel in Hindi, Kavathum pillu in Tamil. In botanical nomenclature it is called *Cymbopogon martini* Roxb., belonging to Gramineae botanical family. There are two varieties of Rohisa grows in India such as Motia and Sofia. The former yields palmarosa oil with 90 to 95 per cent geraniol content and the latter ginger grass oil.

The former type usually grows in drier localities in India like Madhya Pradesh, Vidarbha region of Maharashtra while the latter in West Bengal, Tamil Nadu and Punjab. Both these grasses depending upon the soil and climatic condition are tried in Kalahandi and Phulbani districts of Orissa and various hill states of North Eastern India. While they grew well in those areas ultimate success could not come due to absence of entrepreneurship skill.

Cultivation, growth and harvesting is similar to that of Kodipullu described before but time and season varies from place to place depending upon climate and other environmental factors. However in this case the flowers and the top portion of this plant is usually stored in autumn by making bundles. Method of extraction of oil is similar as in case of other essential oil, by adopting steam distillation. Yield of oil varies depending upon the seasons.

As told earlier, motia variety yields geraniol. Geraniol can be isolated from the oil and if isolated it will have much greater use. Gingergrass oil from Sofia variety also have many uses in soap, perfumery and cosmetics.

Both the varieties grows in abundance without much care hence we can get wealth without much effort.

These grasses after extracting oil can be used as raw material for production of paper and paper board. However, for white paper, there is need to bleach the paper. Both grass and its oil repels termites.

CHAPTER 55

CITRONELLA

This grass belongs to same genus and family of Kodipullu and Rohisa as discussed earlier. But it is not the native of India and was brought either from Java or Indonesia or Srilanka. Botanically Srilanka variety is known as *Cymbopogon nardus* Linn while the Java variety as *Cymbopogon Winterianus* Linn.

Both the grasses were tried in India for cultivation and could grow in many places. But concentration efforts were not made so far. The oil can be extracted by adopting steam distillation or by solvent extraction choosing appropriate solvents.

The Srilanka variety oil is priced lower and consumed in the lower grades of soaps and cosmetics. The Indonesian or Java variety of oil is priced higher and is used in perfumery, soap, cosmetics and as raw material for Geraniol.

Srilanka variety of oil contains γ - cardiaene and elemicin, previously reported as hydrocarbon - B and alcohol - B respectively. Isolation of these compounds may enhance the value of oil.

In India however, the Srilanka variety grows faster perhaps due to environmental similarities. The superior Indonesian variety needs more care at growing stage but is gradually being naturalised. However, yield of oil in the grass grown in India is lower than these grown in the countries of origin.

The spent grasses being cellulosic can be excellent raw material for manufacture of paper and paper board. It can also be good animal fodder and manure.

CHAPTER 56

LEMON GRASS

This grass also belong to same genus and family of Kodipullu, Rohisa and Citronella. Grows naturally in Kerala, particularly in Travancore belt, Srilanka and Ghana. Commonly referred to as Lemon grass but in botanical nomenclature it is called *Cymbopogon Citratus* Stapf. belonging to Gramineae botanical family

Lemon grass like Kodipullu grows well on hill slopes and is basically a rainfed crop. It needs warm tropical climate but does not develop on marshy land, never on water logged land. It grows well on well drained sandy loam. The land need not be fertile. Warmth and sunshine conduce to development of oil in the plant.

Transplanted crop is found to be superior to the directly planted crop or wild crop in respect of yield of grass, oil and citral content in the oil. Hence for commercial cultivation cares are taken accordingly. For growth of plant use of manure is resorted to, and care is taken to remove weeds since growth of weed not only affects growth of grass but also yield and quality of oil.

Time of harvesting of grass is important for yield and quality of oil. Tender grass yields less and inferior oil. Harvesting of matured grass is always preferable. Cutting of grass is done at about 10 cm above the ground. The grass is steam distilled in copper kettles to get oil as in case of others.

Lemon grass oil from Kerala yields 70 to 80 per cent citral, that from Srilanka 75.8 to 82.5 per cent citral while that from it yields 70 to 78 per cent citral. Obviously the Srilanka variety is the best out of the three.

Lemon grass oil is used in soap, perfumery and cosmetic industry. It is an excellent mosquito repellent. Since it does not

irritate the skin it can be applied on the human body to repel mosquito. Its value can be further enhanced if citral can be isolated.

Spent grass after distillation is usually used as manure after converting into compost. It can also be used as cattle feed. But best should be if it is used as raw material for paper and paper board. However for white paper it need to be bleached.

Cultivation of lemon grass is tried successfully in North Eastern India but its virtues are not exploited properly due to absence of infrastructure and entrepreneurship skill. Appropriate planning and implementation is therefore necessary.

CHAPTER 57

RUBBER

In the year 1876, the Britishers picked rubber seeds from Amazon and planted them in their gardens. The resulting seedlings were sent to the British owned lands in. For Eastern Asia, the natural rubber plantations in Malayasia, Indonesia, Sri Lanka and other parts of the world commenced from the above seedlings.

Rubber plant belongs to the family of Euphorbiaceae. Botanically this is known as, *Hevea brasiliensis* Muell. The prominence of this plant lies in its, latex, which oozes out on tapping at the bottom of the tree about 50 to 60 cms from the ground level. Due to this important product, this plant is cultivated on a large scale commercially.

Knowing the suitability of the soil and demand for rubber, rubber plantation was started for the first time at Periyar and Poonoor, now in Kerala State in 1905 by British planters. It was the beginning of rubber plantation in India.

As, subsequently, the plant started spinning money, the cultivation started spreading from South India. In concentration of rubber cultivation was noticed throughout Kerala, notably Kozikode, Kottayam, Quilon and Trivendrum districts, besides Kanyakumari and Coimbatore districts of Tamil Nadu and Coorg region of Karnataka state. Recently rubber plantations were started in Assam, Tripura, Manipur and Nagaland of North Eastern India, West Bengal and Orissa in Eastern India in limited areas.

The credit for having given the name "Rubber" goes to Joseph Priestley on British chemist. While describing the properties of natural elastic gums, he had coined this name for this product. In 1770, he had examined a substance which can be used to wipe out, marks of black lead pencils on the paper.

Around 1735, Lacondamine in his report to the French Academy, referred to the native rubber of the Amazon by the Red Indian name, "Cahutchu". Later on, the name 'Caqutchoue' too its birth from the original Red Indian name and then onwards, this was used to describe natural rubber.

The original source of Rubber was from many wild species of *Hevea*, *Manihot Glazliovic*, *Castilloa Elastica*, *Ficus Elastica*, *Landolphia*, *Parthenium Argenatum*.

In places where rainfall is high and temperature varies from 20°C to 35°C, having hill slopes are better suited for rubber cultivation. Although rubber trees can be grown in temperate Zones, it gives maximum yield nearer to equator. The climatic condition of Kerala notably around former Travancore state ideally suited for this cultivation. Generally it takes 6 to 8 years to obtain the latex. During this period itself one can expect the yield of seeds from the plants and honey from its leaves. Health seedlings are collected for cultivation from the nurseries.

The economic life of the plant is at least 40 years. The plant grows to a height of 20 to 35 metres. The girth of the plant is around one to two metres. Leaves are trifoliate, each about 20 cms. in length. Rubber plant has one peculiarity. Instead of flowers its nectars are in the leaves. Hence availability of honey is round the year instead of being seasonal in case of other vegetations. More so availability of honey in rubber is plenty. Besides for its latex economy of Kozikode and Kanyakumari changed drastically because of rubber honey. It is reported about 75 per cent of the total honey produced in India comes from these two districts. It is reported that each bee boxes gets filled up every hour near rubber plantations when weather is appropriate. But there is disadvantages too. While the leaves have nectars, it does not have pollens. Therefore, rubber honey does not have minerals or vitamins which usually comes from pollens. It only contains sugar in the form of luvlose, glucose and sucrose. Percentage of luvlose in rubber honey is more while sucrose is negligible.

Principal product of rubber tree is natural rubber. Its latex contains 20 to 35 per cent of a rubber constituent, formed by biochemical synthesis. The latex is drawn from notches by tapping. Latex contains the rubber in the form of tiny pear like particles or globules, which are suspended in water and bear a

negative electric charge; this prevents them from coagulating. Latex also contains a small amount of protein substances (2%), resins (upto 2%), sugary substances (0.4%) and ash (0.5%). To remove the charge from the rubber particles formic or acetic acid diluted with water is added to the latex; this causes the latex to coagulate and the rubber is separated in the form of doughy, bulky mass. The rubber is filtered off, thoroughly washed with water and passed through corrugated rollers. The rubber sheets produced are dried and smoked in a smoke chamber so that they will keep without spoiling. The sheets are packed in bales.

Natural rubber is a polymer of isoprene $(\text{CH}_2 = \underset{\text{CH}}{\text{C}} - \text{CH} = \text{CH}_2)$. The macromolecules of natural rubber is made up of $(\text{CH}_2 - \underset{\text{CH}}{\text{C}} = \text{CH} - \text{CH}_2)$ structural units.

The degree of polymerization exceeds 2000 and molecular weight is from 136000 to 340000. Natural rubber possesses high strength and elasticity within a wide range of temperatures. The rubber is used after galvanization which gives stability.

Natural latex is also used directly, without separate the rubber from it. It is used as a glue, for impregnating textiles and making microporous rubber.

If sulphur is added to natural rubber which is then heated, the sulphur will form links between the linear macromolecules of the rubber i.e. form bridges between them; by this larger macromolecules of a web structure will be produced. This process is called vulcanization of the rubber, and the product of reaction between the rubber and sulphur is vulcanized rubber. Vulcanization improves the mechanical properties of the rubber and increases the range of temperatures within which the elasticity of the material is retained; it also increases the resistance of the rubber to organic solvents etc. Rubber is being used various ways in our day to day life. Most common are automobile tyres, drive belts and conveyor belts, flexible hoses and sleeves, machine parts and various gaskets, electric insulating materials, rubberized fabrics, rubber footwears, articles of personal hygiene and many more.

Rubber flower appears during the month of February and March. The flowers are monoecious, small, creamy, yellow or light green and sweet scented. It is reported to contain essential

oil which can be extracted either by steam distillation or by solvent extraction.

Rubber fruits appear between August and November. The fruits are ellipsoidal, and tricarpu (capsule having three seeds). Dried fruits are obtained in June. The capsule of the fruits starts breaking with onset of monsoons. The seeds fall down in this season only. It has been observed that old plantations will give better yield of seeds than new plantations. The seeds are brownish and oval in shape. It is about three times castor seed in size and resembles its outer coat. Each seed weighs 2 to 4 gms and are lighter than water. The seed coat is brittle. The seed kernel is white in fresh condition and turns yellowish brown on drying.

Kernel is 5 per cent of the fruit and 50 to 60 per cent of the seed kernel yields 45 to 52 per cent oil. Fruits on the tree open up when sun shines, dropping down the seeds, which is collected by hand picking. To avoid deterioration due to moisture infection by pests, seed is immediately decorticated and the kernel is dried and stored. Extraction of oil is made either mechanically by hydraulic press or chemically by solvent extraction, and depending upon the method of extraction, would give different grades of colour of oil from water white to pale yellow. Yield is usually 33 to 35 per cent. Properties of rubber seed oil are given below.

Properties of rubber seed oil

Colour	- white/pale yellow/dark yellow
Refractive index at 15°C	- 1.466 to 1.469
Specific gravity at 15°C	- 0.924 to 0.930
Titre	- 28 to 32°C
Iodine value	- 132 to 141
Saponification value	- 190 to 195
Acid value	- 4 to 40
Hydroxyl value	- 12 to 32
Unsaponifiable matter	- 0.5 to 10%

Fatty acid composition of rubber seed oil is given below :

<i>Fatty acids</i>	<i>Percentage</i>
Palmitic	7.5 to 11
Stearic	8.6 to 12
Arachidic	0.3 to 1.3
Linoleic	21 to 26

This oil can be used upto 30 per cent in soap making. It can be used in paints and varnish industry as partial substitute for linseed oil. This oil is effective against house flies and lice. However, inspite of other properties it can not be used as edible oil due to presence of lipids.

The seed contains cyanogenetic glucocide, linamanin, phaseoverty lunalin and few specific enzymes. Both seed and oil contains active lipase. This lipid is responsible for breakdown of oil. Method of isolation and use of this lipid yet to be determined but it is believed it is because of this lipid that the oil acts against flies and lices.

Oil cake positively a good manure having good NPK value. As cattle feed, it is claimed to be most digestable, palatable and value equal to that of linseed oil cake for supporting milk production. This cake contains 30 to 33 per cent protein, 40 to 44 per cent carbodhydrates and 5.6 to 6 per cent mineral matters. Due to high percentage of protein it can be used for manufacture of adhesives needed for plywood industry. Cake also yields about 0.03 per cent Prussic acid.

There is a lot of scope of R & D enhance the scope of use of rubber. The Kernal contains a powerful act. g hypolitic enyme and a cyanogenetic glucoside resending phaseoulunatin (a dextrose ester of acetone Cyanohydrin). Seed also yields 0.048 per cent of Prussic acid.

The wood of rubber is soft and unfit for timber. But it can be used for manufacture of splint and vaneer in safety match industry.

Except latex no serious thought is given for exploitation of other virtues. Even the most of the rubber seeds are lost since it is not considered as commercial. Rubber is now gaining popularity as a decorative garden or avenue plant. But unless virtues are exploited properly as discussed people may not get encouraged to propagate growth of this wonderful plant already naturalised in India.

CHAPTER 58

NETTLES

Nettle species were grown in Europe since pre history particularly for their fibres. There are a number of species of nettles growing wild in India out of which *Urtica heterophylla* Linn., *Urtica Urens* Linn. and *Urtica dioica* Linn. are reported to be common in this subcontinent. All these species belong to Urticaceae botanical family.

These plants were originally discovered in the Nilgiri hills and from this circumstances came to be known as Nilgherry nettle during the East India Company days. But it is come across throughout coastal Kerala, in Burma, Assam and North Eastern India and the district of Dehra Dun along the foot of the hills.

Stem, leaves and roots of the nettles common burdock (*Arctium lappa* Linn.), gentian (*Gentiana latea* Linn.) and St. John worts (*Hypericum perforatum* Linn.) finely powdered and extracted with hot water at 75 to 95°C and the extract made into an ointment with beef marrow fat makes an excellent hair restorer.

The seeds germinate quickly. The cultivation can be carried on to an unlimited extent. But the plant is regarded as insignificant in India. It grows wild; nearly every where in India it is regarded as a nuisance.

Nettle is an annual with erect angular stems with white specks. In these specks happen to be quartered very stiff and acute bristles which causes temporary skin irritation on very touch.

The bark of this plant abounds in fine, white, strong glossy silk like fibre. Fibre in pure form can produce attractive textiles and can be used effectively by mixing with wool or other fibres. In Nagalan and Manipur Zeliangroung tribes weave beautiful shawls using nettle fibre. But use of this fibre is being

discouraged systematically due to introduction of mill made synthetic yarn for weaving.

The extraction of nettle fibres is similar to that mentioned earlier for the atasi or linseed plant. The fibres are freed from the stalk in all the three ways - dew retting, water retting and mechanical decortication. The material is then boiled, hackled, combed and oiled. The production of fibre is said to be as high as 20 per cent of the weight of green bark when harvested. If properly prepared the fibre becomes soft, flexible and white.

This fibre, is very popular fibre in Europe where it is called Swedish hemp. The plant has long been cultivated in Sweden for the production of a fibre for manufacturing cordage and sail cloth. The fibre was used on a large scale in Germany, Russia and Italy in the middle ages, in manufacture of yarn. At the beginning of the 19th century there was a very extensive trade in nettle goods in France, Germany and Sweden. Thereafter, it started losing the importance due to invention of other vegetable fibres and finally death nail was struck with the invention of synthetic fibre.

Synthetic fibre is not biodegradable hence are not environmentally clean therefore has to be discouraged. Moreover, synthetic fibre begin petroleum derivative if discouraged shall preserve our future fuel stock. Nettle fibre on the other hand is environmentally clean, and renewable. Why not encourage this virtue and bring back the lost tradition.

CHAPTER 59

BIMLI

Bimli is one of the popular fibre crop in India. Known as *Hibiscus Cannabinus* Linn., as per botanical nomenclature belonging to Malvaceae botanical family. This plant is known as Kenaf or Mesta or Dean hemp in English, Nalita in Sanskrit, Ambadi or Patsan in Hindi and Marathi, Kannria in Oriya, Mestapati in Bengali, Sankokla in Panjabi (Gurumukhi), Pundi in Kannada, Kanjuru in Malayalam and Gogu in Telugu.

Among the leaf and bark fibres in India bimli stands next in importance only to jute. It is an erect herbaceous annual with straight slender glabrous stem 3 to 4 metres high. Bimli is apparently indigenous to India. It has been in cultivation here from pre-historic times. Some of the bark cloth mentioned in the Sanskrit literature is thought to have been made from this fibre. It occupies a place of importance in the drier tracts of Deccan, Madhya Pradesh and Bihar. In other areas the plant is cultivated on a limited scale, as a supplementary crop with others. It thrives well within 45°N and 30°S latitudes. Thus bimli is essentially a tropical crop.

It thrives best in a humid climate within a temperature range of 15°C to 25°C, during growing season. It requires a rainfall of 50 to 60 cms distributed evenly over a period of 4 to 5 months. During this period it should receive day light for at least 12 hours. The plant can grow on a wide variety of soils. It does not need a fertile soil. The best results are obtained on a moderately rich fertile loam. But it does not grow under water logged conditions. The plant is not as exacting as jute. For this reason it is preferred as a jute substitute, and is extremely popular wherever jute has failed. In India, the alluvial soils of Gujarat, the black soils of Deccan and the red loam soils of South India are regarded as the best for the plant.

In our country, it is grown mixed with others crops such as bajra and jowar. It is also grown as a hedge crop. The seeds are sown broadcast or are drilled. Except for thinning in the earlier stages and one or two hoeing till the plant attains a height of 30 cms, practically no attention need to be given to the crop. It becomes ready for harvesting in 3 to 5 months. In India cultivation is either by hand or bullock power.

If the crop has fibre for its object, the harvesting ought to be done at the flowering stage. If delayed, the fibre becomes coarse and lustreless. The plants are cut close to the ground or are pulled out tied into bundles of 30 to 40 stalks, left on the field for a few days to dry and then steeped in water for retting.

The method of retting bimli is the same as for jute or hemp. The leafy tops are cut off, the bundles steeped vertically in water for 2 to 3 days to soak the thick basal parts, thereafter steeped in a horizontal position. The period of retting varies from 6 to 10 days depending on maturity of the crop at the time of harvesting, the temperature of water and the type of macro-organisms present. Under-retting does not facilitate the easy removal of the fibre, besides it makes the fibre harsh and brittle. Over retting weakens it.

After completion of retting process, the bundles are taken out, the bark peeled off from the root upwards, the stripes partly beaten, rinsed in water to separate the fibre from the tissues. The fibre thus cleaned is then washed, dried in the sun and made into bundles of hanks for marketing.

The fibres can be freed from the pulpy tissues from the bark mechanically by scutching in a decorticator too. The extraction by the decortication method involves the following operation. The stalks are cut to appropriate lengths as soon as possible after harvest; the base of the stalk is scutched on the first drum of the machine and then brushed on another.

One advantage of extracting the fibre by mechanical method is that the output per day is higher and the produce becomes ready sooner. The disadvantage is that the cost of the machinery is high for all the small growers to bear and the wastage is higher. Apart from this the semiprocessed fibre resulting from mechanised extraction is short stapled and difficult to spin

unless processed further. Thus the following advantages arise from the retting process which is so popular in India :

- (a) the fibre obtained is soft
- (b) the cost of extraction is lowest
- (c) it can be practised wherever water is available and no need arises to plant any machinery or to convey the bark over long distances.

Bimli is used widely for rope and cordage. Considerable quantities are used in the manufacture of fishing nets and tying rafter. It is also used for making coarse canvas, sacks, floor matting, rug backing, chair backing etc. Being similar to jute in spinning properties it is used on a fairly large scale in jute manufacture particularly in the manufacture of hessians. Glossy bimli fibre can be used for manufacture of fancy items like table mats, wall hanging etc. Bimli is suitable for paper pulp too. Even today fibre of poor quality is used for paper making.

However, there is need to examine the use of bimli gum after fibre is extracted for any use. Bimli seeds also yield oil but no study yet done for utilisation of the oil. Flower has the nectar, hence beekeeping industry can also be planned. Woven fibre after resin moulding may give us much durable useful products. If all these aspects are tried value of bimli plant may further enhanced.

CHAPTER 60

KUSUM

Kusum tree grows wild in dry to deciduous mixed forests in the sub-Himalayan tracts upto the altitude of 914 metres in Central and South India. It is a large deciduous dense tree and has shady crown. It grows upto 10 to 12 metres high.

Known as *Schleichera trijuga* Willd., in botanical nomenclature and belongs to Sapindaceae botanical family. It is also known as Koshamra or Kripa in Sanskrit, Kusum or Jamoa or Suma in Hindi, Busi or Pusku in Telugu, Sagade in Kannada, Puvam in Malayalam, Pumaratha in Tamil, Kosum or Kochan in Gujarathi, Kosam in Marathi, Kusamo in Oriya, Kusum or Kosano or Jalpai in Bengali and Ceylon Oak in English. Besides having wild growth it is also cultivated in Orissa and Bihar for lac culture.

The tree matures in 10 to 15 years. Its wood is hard and is a good timber often used for manufacture of furnitures and fixtures. Bark yields tannins and various saponins and considered to be medicinal by local medicine men. Leaves are good for cattle fodder and for green manuring.

Flowers appear during the months February to April. The borne in dense clusters and are yellowish green in colour stalk less and small. They yield good amount of vegetable dye. It has nectar and yield sufficient honey for growth of beekeeping industry.

Fruits appear during the month of June and July. They are one called, smooth or slightly prickly, globuse or ovoid, hard skinned berry with a pointed tip, usually 2 X 1.8 cms. Contains one or two ellipsoidal slightly compressed seeds with a thick brown seeds coat. Although having very little pulp, yet is edible since it gives cooling effect like mentha. Pulp contains ascorbic acid (Vitamin C) and are highly digestive. Seed coat contains tannin,

if isolated can be used for leather industry.

Seed contains 26 to 38 per cent oil. About 60 to 64 per cent of the nut is Kernal which is U - shaped soft but susceptible to fungal attack. Bunches of fruits are plucked by climbing trees, depulped by rubbing in water and dried. Oil extracted by mechanical crushing after decortication. Crushing by expeller yields about 36 per cent. The oil is stimulating and has cleansing effect on scalp. It is extremely good as a lubricant but toxic due to presence of hydrocyramic acid hence can not be used as edible oil. The properties of Kusum oil is given below.

Properties of Kusum Oil

Colour	- Yellowish brown
Odour	- Characteristic
Consistency	- Semi solid
Refractive index at 40°C	- 1.459 to 1.462
Iodine value	- 48 to 58
Saponification value	- 220 to 234
Unsaponifiable matter	- 1.5 to 3%

Composition of Kusum Oil is given below.

<i>Fatty acid</i>	<i>Percentage</i>
Myristic	1.0
Palmitic	5.3 to 8.7
Stearic	1.7 to 6.3
Arachidic	20 to 31
Lignoceric	1.5 to 3.5
Oleic	40 to 67
Linoleic	2.5 to 5.2

Oil can be used upto 15 per cent in soap formulation. Kusum soap gives better lather and feel. It has hard consistency and has property to resist rancidity. It is mostly used in small units where glycerine extraction is not made. Kusum oil contains cynolipid as non-glycerol esters. CN' is injurious to process vessel for glycerol extraction and it must be removed from the oil, so that it can be used as a raw material at least for laundry soap.

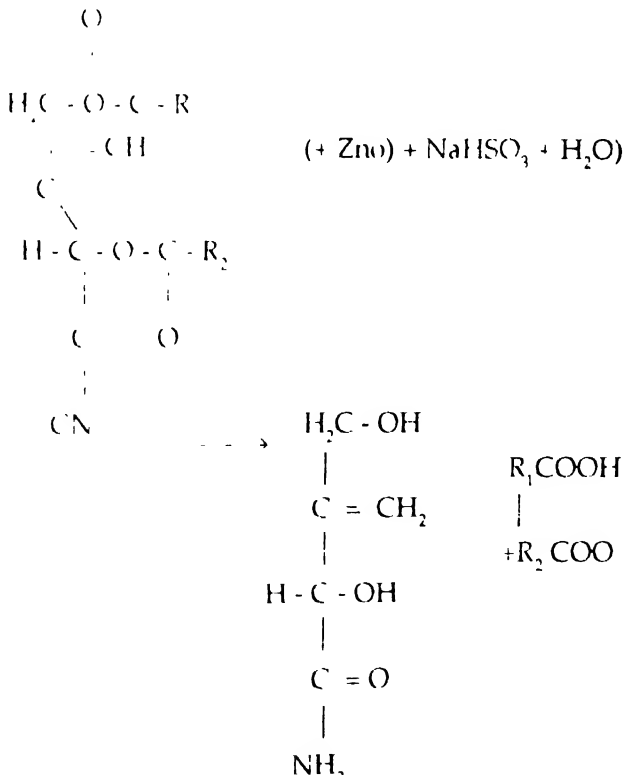
The CN' is completely removed in two stages viz. (a) Treatment - hydrolysis with Zinc Oxide and Sodium - bi - sulphite, (b) Saponification and washes till the soap is CN' free.

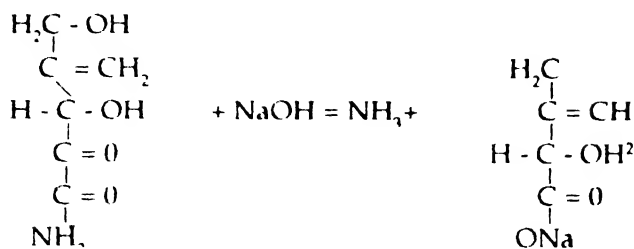
Equipments

- (1) Pressure vessel
- (2) Two oil storage tanks
- (3) Soap Pans
- (4) Mixing vessel
- (5) One centrifugal pump
- (6) Two Sigma Pumps

Reactions

(a) Treatment



(b) *Saponification**Proportion of Chemical used*

- | | |
|----------------------------|--------------|
| (1) Zinc oxide | 1.25% of oil |
| (2) Sodium - bi - Sulphite | 2.5% of oil |
| (3) Caustic Soda Solution | |
| (4) Brine or Salt | |

Time Cycle

- (1) Treatment - 14 to 15 hrs per batch
- (2) Saponification including washing 15 to 16 hrs per batch.

This CN' free soap is usually mixed with already saponified mixed oil soap at later stage. However, the glycerine in oil is completely lost in above process. But if appropriately designed pans are used, there is possibility of getting amonia either as gas or as ammonium hydroxide by absorption which can be utilised for manufacture of chemical fertilizer.

Oil cake contents 23.31 per cent Protein and NPK value of 5.5 : 2.08: 1.13. Hence it can be a good manure and as a raw material for adhesive industry. It could have been a good cattle feed but can not be used due to presence of Cynogenetic compound. However it can be used as a fuel after drying.

One of the most valuable product that the plant gives is lac. However it should be noted that the tree can not stand heavy pruning. Light pruning is advised for lac production . Lac can be used as a scaling lac and in paint and varnish industry. Lac also used for manufacture of dyes and has export demand.

Except where lac production takes place, this tree is a victim of both afforestation and deforestation. Efforts should be made to preserve this tree and exploit all its virtues.

CHAPTER 61

AKHROTE

Akhrote is basically popular as a dry fruit grows wild as well as cultivated in Jammu and Kashmir, Himachal Pradesh and hill districts of Uttar Pradesh. It is a medium sized plant growing in medium and high altitudes. It is known as Walnut in English, Akrod and Akhrote in Indian languages. In botanical nomenclature it is called *Juglans regia* Linn belonging to Juglandaceae botanical family.

The wood of Akhrote plant is dark mahogany coloured and maintains its gloss even in odd situations. Inspite of being hard it can be carved well and is used in Kashmir for manufacturing fancy wood carving items for which Kashmir is well known.

Round shaped uneven surfaced matured fruit with very hard cover is popular as a edible dry fruit. While soft dried pulp inside is consumed, its hard cover often used for production of fancy decorative items at cottage scale.

Aqueous extracts of leaves, free of juglons possess strong bactericidal activity against micro organisms. The leaves and the green pericarp of the unripened fruit have phytocidic property. Leaves also yield hydrojuglone and Vitamins B and C.

A globulin, juglansin, can be isolated from Kernals which also contain vitamins of B group and Vitamin A. The immature fruit is the richest source of ascorbic acid.

The Kernals yield 60 to 70 per cent oil. Properties of Akhrote oil is given below

Properties of akhrote oil

Specific gravity at 25°C	-	0.9235
Refractive index at 25°C	-	1.4781

Saponification value	-	194.5
Iodine value	-	161.7
Acid value	-	5.1
Hydroxyl value	-	6.1

Fatty acid composition of akhrote oil is given below.

<i>Fatty acid</i>	<i>Per cent</i>
Myristic	0.01
Palmitic	4.6
Stearic	0.9
Oleic	17.8
Linoleic	73.4
Linolenic	3.3

Akhrote oil is certainly a good raw material for soap making due to its high saponification value but can not be used at high proportion since soap tend to become soft. However, it can be used at high percentage after hydrogenation. Due to high percentage of unsaturated fatty acids it could have been an ideal edible oil but it can not be used as edible oil due to high hydroxyl value and acid value. It can be used as a lubricant.

Oil cakes can be used as cattle feed and manure. It can be used for isolating globulins and can be edible after processing. It can be used for manufacture of adhesives. It can be utilised for isolating various vitamins as reported earlier.

It can be taken up in afforestation programme at identical appropriate situation.

CHAPTER 62

CASSAVA

Cassava is a native of South America but cultivated throughout the humid tropics. In India it is grown in Kerala as a subsidiary food crop and as an excellent raw material for Sago manufacture.

In English it is commonly known as Tapioca in Assamese and Bengali Simal Alu while in Kannada and Malayalam as Marangenasu and Marachini Kizhangu respectively. In botanical nomenclature it is called *Manihot esculenta* Crantz. It belongs to Euphorbiaceae botanical family. It is known as Cassava commercially.

Cassava is the staple food of the poorer section : It is consumed like sweet potato in the form of tubers, chips, flour and sago. Under the name of Cassava rice, dried pellets made from the tuber juice, used as substitute for rice and maize. The starch content of the tuber varies from 77.5 – 88.5 per cent.

The juice of fresh tubers contains phosphorylase, Q-enzyme, Pyro - and glycerol - phosphatases. Tuber besides starch also contains protein. Liquid glucose from the Cassava starch conforms to standard liquid glucose.

Diurnal variations in Cassava leaves in some enzymes of Carbohydrate metabolism is reported.

Cassava Suji is prepared from peeled tubers as substitute of wheat suji is gaining popularity. Cassava sago is also gaining market demand. It is reported Cassava sago when taken with milk, increases milk in mother's breast. Cassava macaroni, a blend of Cassava flour, groundnut flour and wheat semolina was developed by CFTRI, Mysore. The finished product appears like undermilled rice and contains twice as much protein as rice.

Cassava is a quick growing plant and total food item given to us by this plant by weight is much more than any other cereal crops. It does not need much care at growing stage. Perhaps this plant may be an answer for our growing need of food in a country like ours where population explosion is unavoidable.

CHAPTER 63

RHEA

In a way Rhea or Ramie fibres may be considered as prince among the vegetable fibres due to its look, strength and utility. It is referred in English as Ramie or Chinagrass in Assamese and Bengali as Rhea and Kawkura respectively. In botanical nomenclature it is called *Boehmeria Ramie*. It is reported to be indigenous of China, Japan, Far Eastern countries and North Eastern India, or in other words the Mongolian tracts. But it has been in use in India from pre-historic times. In early Sanskrit epics it is often mentioned as grass linen.

In India this plant grows as a garden crop under the name of Kankura and grows wild as Pooah in sub-Himalayan tract and as Rhea in Assam and North Eastern India. Rhea plants grow best in a warm moist climate, tropical, sub-tropical or temperate regions as far north and south 40° latitude. In sub-tropical and temperate regions it grows best on an elevation of 300 to 400 metres. In the tropical areas an elevation of 900 to 1100 metres gives the best crop. Rainfall should average not less than 7 to 8 cms per month evenly distributed throughout the year. Periods of excess rain, water logging or heavy drought is detrimental to the crop. The preferred soil is a moderately rich loam, loose and friable and well drained. The crop exhausts the soil fast, hence heavy manuring at frequent interval becomes necessary.

The propagation is usually by means of stem cutting. The plants can also be raised either from seeds or from roots. If properly cultivated no replanting becomes necessary for 6 to 15 years, depending on the soil and the climate. The root system gives rise to abundant fresh roots after each cutting of stems. It takes about 10 months for the stem to mature after the first planting, depending on climatic and other conditions. For

obtaining soft fibre, shoots must be cut before they mature and begin to flower. The quality of the fibre depends on the age and the length of the shoots. Shoots not more than 60 cms high give the best fibre but quantity is small. In long stems the fibre is coarse. Hence shoots one to one and a half metres high are normally preferred.

When the root system is well established, a crop may be harvested during the warm growing season on the average of one in 60 days and the plants will continue to produce stalks of goods quality fibre for 5 to 15 years. But when the roots become matted, the fibre produced by the plant becomes coarse. In areas where only one crop in a year can be taken the plants are known to live and give good fibres for 20 to 30 years.

Rhea fibres occur in the form of bast bundles with the ends overlapping so as to produce continuous filaments throughout the length of the stalk. They are held in place and to each other by gums, waxes and pectins, firmly.

Decortication is done in two ways by hand and with the help of machines. The areas where hand decortication is practised, have each their own special process. The only point where all are agreed upon is the removal of leaves from the stalks. In some areas, the bark together with fibres adhering to it is peeled away from the stalk. The fibres are later on freed from the woody portion i.e. the bark, by alternate soaking in water and scraping, this process goes on till the fibres come out clean and white. The separation of the stalks from the bark with the fibre is done in some areas by peeling and some by beating the canes till the latter come out. In some areas freshly cut stalks are treated for this operation. In some the stalk is allowed to dry. In some areas to freshly cut or dried stalks, with the bark and fibre on, are soaked in water for few days to facilitate the peeling. The beating is done by pounding in some places. In others the stalks are dashed against stones or wood. The soaking of the separated bark with the fibres adhering is done in some places in still water, in some places in running water. In some areas fresh water is used while in some saline water is used for soaking. Depending on the area cold, warm or hot water is used for soaking. The tools used for scraping also vary from place to place.

The fibres thus produced are in the form of stands with gums and pectins adhering to them, besides of course waxes. Hence they are to be degummed. This is done by repeatedly soaking, scraping, washing and sundrying the fibres. In some areas a lye, made from ashes or lime is used in the soaking water.

Mechanical decortication has developed in various countries since the year 1800, and a number of machines were developed since then, working on the raspador system now commonly used in India for extraction of various fibres like Sisal, pineapple, banana etc. Based on same principle a portable machine was also developed in Japan. A special type of decorticator and a brushing machine work together. The former treats the full length of the fibre in one operation when the canes together with the leaves are fed at one end by hand. The fibres thus decorticated and dried are brushed by the other machine.

Degumming has to be done after decortication as otherwise the fibres become brittle and weak, due to the presence of gums, waxes and pectins. Proper degumming separates the individual fibres and leaves them in a soft clean state with their strength and other characteristics intact. Ultimate quality of fibre depends on the skill of degumming.

There are two basic methods for degumming on a commercial scale e.g. bacteriological and chemical. In case of rhea, bacteriological method did not succeed so far. The chemical process of degumming starts with boiling the fibre in caustic soda solution. Quantity and concentration of caustic soda depends on the quantity of fibre and amount of gum in it. Time taken for cooking also varies accordingly. After the cooking, the fibres are rinsed, neutralised, washed and centrifuged several times finally oiled and dried. If necessary the fibre may be bleached before oiling. Fibre content in rhea cane varies between 2 to 3 per cent.

Rhea fibre is naturally white. It resists the effects of bacteria and fungi including mildew remarkably well. It is strong and durable. Of all vegetable fibres, it is last affected by moisture. It is said to possess three times the strength of hemp. The fibre can be separated to the fineness of silk. It takes dyes easily. If bleached properly, it gets snow white in appearance. It does not become dirty easily. It possesses a beautiful lustre equal to that

of silk and superior to that of linen. It has high absorption properties.

Rhea is used in Europe for sacks, sail cloths, belting, table cloth, sheeting, nets, threads, cordage, paper etc. Gas mantles of good quality are also made from it. But it is rarely used by itself in textiles. It is mixed with wool silk and cotton. Its special use in the manufacture of lustrous non-creasable fabrics. Government of India is keen to develop this fibre since this plant grows wild in Assam. A research station has been established in Guwahati.

It leaves can be used both for green manuring and fodder. Attempts should be made to isolate wax, gums and pectins from the spent lye after degumming. Fibre also can be used as raw material for paper and pulp industry. Medicinal value of its root or stem was never investigated nor its seed which might contain oil or important organic chemicals.

Rhea is an commercial fibre plant in Japan but in India it is considered as one of the useless vegetation though grows in abundance. Final result being it is eradicated due to urbanisation or development or afforestation or defforestation.

CHAPTER 64

GUAVA

Guava is one of the most popular fruit all over India. It is known as Amrut in Hindi, Pijuli in Oriya, Pyara in Bengali, Peru in Marathi and Guava in English. In botanical nomenclature it is called *Psidium Guajava* Linn and belong to Myrtaceae botanical family.

Guava fruit is usually consumed raw or in the form of jelly or jam normally. It is also consumed as a part of fruit salad. For preparing jelly, ripe fruit is cut into pieces boiled in sugar solution and become viscous liquid which on cooling becomes semi solid jelly, consumed with bread.

Fruit normally contains essential oil but essential oil is more in allahabad variety with yield of 0.31 per cent. Ripe fruit also yields dl - limonene. Ripe guava fruit pectins such as 1-arbinose, d-galactose and d-galacturonic acid to the extent of 4.4 per cent, 12.05 per cent and 72.03 per cent respectively. Fruit also contain some calcium in the form of glucose, dextrose and sucrose, and hence is stimulating.

Guava leaves contain β - sitosterol, maslinic acid, guajavolic acid and an unidentified acid. Hence if they can be isolated and utilised, they will have pharmaceutical use. The plant also yields β - sitosterol.

Stem bark is usually used in indigenous herbal medicines. Dried stem bark powder believed to cure gum diseases hence used in herbal tooth powder and pastes. It is reported to contain ellagic acid in various proportions.

Guava plants are grown basically for its fruit so popular in India. It is also grown as a garden plant. It grows wild all over India and are being encouraged as an avenue plant.

CHAPTER 65

PADMA

Padma or lotus flower symbolically extremely sacred for Hindus in India. It is believed that Hindu God and Goddesses have their seat on this flower. There are a number of species of lotus found all over the world but in India most common being sacred lotus which is called *Nelumbo naciifer* Gaertn according to botanical nomenclature. Others varieties those are seen commonly are *Nelumbium speciosum* Willd and *Nelumbium nelumbo* Druce. All these species belong to Nymphaeaceae botanical family

Through it is commonly believed that lotus honey cures eye diseases, it may be noted that lotus flower do not have any nectar hence do not yield any honey. In spite of that how such belief was established is certainly a misnomer. Nevertheless all the part of this plant is medicinal

Leaves large in size, more than 30 cms in diameter floats on water. Often used as plates for serving food in way side hotels. Leaves yield alkaloids nuciferine, roemerine and nornuciferine. Fresh leaves on extraction yields nelumboside 0.1 per cent which is quercetin 3 - glucoglucuronide.

Petals pounded and administered for syphilis. They are given to remove 'Kapha' and 'Pitha'. Petals are also sedative in the uterus, good in thirst, piles, inflammation and poisoning.

Embryo (called mekula) used to reduce high fever and used in treatment of cholera, haemoptysis and spermatorrhoea. It is also used as part of herbal preparations for various other diseases particularly related to stomach.

Rhizome yield a kind of arrowroot which is administered for diarrhoea and dysentery. A tea is made for menorrhagia particularly for Eastern countries.

Lotus or Padma although considered sacred, never cultivated in India. It grows wild in ponds and often cut and removed when even the pond is cleaned. This plant need attention of elites as otherwise it may ultimately become endangered species inspite of having so many useful qualities.

CHAPTER 66

VANAVRINTAKI

There are a number of plants which grows wild but are considered useful in the point of view of medicinal utilities. Vanavrintaki is one such plant which grows wild in abundance in Khasi hills of Meghalaya, other hilly areas of North Eastern India besides Himalayan and sub Himalayan tracts. It is also called Brihatta, Kandyari, Byakare, Ringani, Papparmulli, Chittimulaga and Nilavalutina in various Indian languages. In botanical nomenclature it is called *Solanum indicum* Linn and belong to Solanaceae botanical family.

Fruits of this plant contain 1.8 per cent of alkaloids and can form a good source material for cortisone and sex hormone preparation. Berries of *Solanum khasianum* clarke, of same genus and family yields 0.7 per cent of Solasonine so useful for various pharmaceutical preparations.

Leaves, bark, stem and root of this plant is reported to be medicinal used by local medicine men. Leaves are also used as fodder. Stem yields a type of crude fibre, can be used for manufacture of ropes after retting and separation from gums. Flowers do have nectar and yields honey. Hence beekeeping industry may be encouraged during flowering seasons.

Seed of this plant yields fatty oil. Properties of Vanavrintaki fat is given below.

Properties of Vanavrintaki fat

Specific gravity at 15.5°C	-	0.9156
Refractive index at 15.5°C	-	1.4671
Saponification value	-	177.6
Iodine value	-	121.5
Acid value	-	17.8
Unsataponifiable matter	-	2%

Fatty acid composition of Vanavrintaki fat is given below :

<i>Fatty acid</i>	<i>Percentage</i>
Lauric	0.6
Palmitic	7.2
Stearic	6.6
Arachidic	1.1
Oleic	35.0
Linoleic	49.5

The seed contains 10.1 per cent fat. Due to high saponification value it can be a good raw material for manufacture of soap. But oil has to be used upto a limited extent since the soap tend to become soft. The soap has good effect on skin due to presence of lauric acid. It may be tried as a edible oil, due to high unsaturation subject to analysis of lipids and their effect on health and neutralisation of acid value which is on higher side. Fat can be used at higher proportion in soap if hydrogenated. Oil cake can be a good manure, animal feed and can used for manufacture of adhesives.

The plant grows wild and is subject to felling for various reasons which need to be prevented.

CHAPTER 67

RASUN

This is perhaps one of the important and popular spices used commonly in Indian food preparations particularly in non-vegetarian foods. Though of vegetable origin it is considered as non-vegetarian by orthodox Hindus in India. It is known as Rasun or Lasun in almost all Indian languages but called Garlic in English. In botanical nomenclature it is known as *Allium Sativum* Linn, and belong to Liliaceae botanical family. It is cultivated all over India and grows as a small shrub.

The plant produces inhibitory effects on Gram - negative germs of typhoid - paratyphoid - enteritis group. Possesses outstanding germicidal properties and all cultures destroyed under their influence.

The root tuber is basically its main commercial product and is edible. It cures rheumatism and arthrities if taken regularly. It also prevent filariasis and malaria. If raw rasun root is kept hanging in the room, it is believed that it purifies atmosphere prevents entrance of snakes and scorpions and makes the atmosphere germ free. It also yields essential oil of a typical odour.

In Indian rasun presence of amino acid and alliin reported. Red variety yield 1 per cent alliin while white variety 0.8 per cent. Bulbs also reported to yield various compounds such as alanine, arginine, aspartic acid, asparagine, histidine, leucine, methionine, phenylalanine, proline serine, threonine, tryptophan and valine.

Bulbs if taken regularly also prevents hyper acidity, gastritis and amoebic dysentery. It has the capacity to stimulate sexual organs. But if consumed in excess causes heat including skin eruptions. It also improves blood circulation improves heart and lung functions and reduces chloolesterol.

Resun is not only part of our food but also considered to be medicine and hence an important crop in India.

CHAPTER 68

PIYAJ

Piyaj bulb is popular all over India as a part of preparation of curries particularly non-vegetarian. Although it is of vegetable origin, it is considered as non-vegetarian by orthodox Hindus in India.

Known as Piyaj all over India. Also known as Kanda in Marathi and Gujarathi and Onion in English. In botanical nomenclature it is called *Allium Cepa* Linn belonging to Liliaceae botanical family. Cultivated all over India predominantly around Nasik in Maharashtra.

The bulb apart from being consumed with curry as a part of food preparation also consumed raw as side dish as well as in salad and pickles. Tender plant is consumed either as part of side vegetable or fried. Fried sliced bulb adds desired colour and flavour to curry, fried rice or biriyani particularly if the dish is non-vegetarian. While bulb is considered as a non-vegetarian diet, the plant is considered vegetarian.

Pure quercetin is obtained from piyaj skin. Flavonoid and other phenolic compounds from dry brown outer scales as well as from fleshy scales. Different parts of the plant yields phenolic acids and sugar components.

Hypodermic injection of 2ml per kg weight of rabbits reported to increase diuresis. Bulb has active principle of glycollic acid.

Tender plant supposed to yield vitamin C and various salts of iron hence helpful in preventing anaemia. Due to presence of Vitamin A it is helpful for eye when consumed.

The bulb is basically coolant and when consumed raw prevents heat stroke. Simply by carrying the bulb in the pocket it

is believed to prevent Sun Stroke. The bulb paste when applied cures insect bite, bee sting, and scorpion sting since it has the capacity to neutralise the lactic acid.

It is basically a small shrub growing upto 30 to 35 cms. It is propagated by drilling the bulb or through suckers

This is one of the most useful vegetation of India today.

CHAPTER 69

PANJULI

Panjuli is a wild grown plant occurring throughout tropical India ascending to 2500 to 2700 metres in Meghalaya and Nagaland. It is called Panjuli in Hindi, Panjali in Bengali, Datwan in Gujrathi, Pavana in Marathi, Nallapali in Telugu, Aturanni in Tamil, Anamsule in Kannada and Kilanchi or Nilneli in Malayalam. In botanical nomenclature it is called *Kirgenelia reticulata* and belong to Euphorbiaceae botanical family.

Although it is not cultivated, it is allowed to grow wild basically since it is a popular medicinal plant used for curing various diseases by the local doctors. Its extract is used both in homeopathy as well as allopathy alike.

The bark of this plant is alternative, attenuant, astringent and diuretic. Since it reacts depending on physical condition of the man on whom it is applied, often its extract are used instead of being in raw form. Stem juice is effective for various eye diseases.

Leaves are diuretic and coolant. Its juice is used with camphor and cubebs (*Piper cubeba*) for bleeding gums, as also for diarrhoea in infants. The juice is also often used for preparation or manufacture of herbal tooth pastes and powder.

Decoction of root is given to children for cough and catarrh. It is used for manufacture of alcohol free cough syrups.

Fruit is astringent and useful in inflammation and diseases of the blood. Extraction of the fruit is used for preparation of tonics. Whole plant is used in the treatment of small pox and syphilis. It is also effective for skin diseases.

The plant grows wild but is a victim of jhuming, afforestation as well as deforestation. It is necessary to preserve and propagate at least for its medicinal virtues.

CHAPTER 70

ARJUN

Arjun known by same name all over India is of Indian origin. It grows plenty in the forests of tribal belt of West Bengal, Orissa, Bihar and Madhya Pradesh besides Vidarbha region of Maharashtra. In botanical nomenclature it is called *Terminalia arjuna* Wight and Arn. and belong to combretaceae botanical family.

Although, it grew wild traditionally, plantation of this plant was encouraged in Orissa, Bihar, West Bengal and Madhya Pradesh particularly for sericulture. Leaves of arjun plant is a good feed for tassar silk worm. The plants are planted such a way that branch of one plant touches its adjoining plant. Its leaves are also used for green manuring as well as fodder.

But if the plants are grown as feed plant for tassar silk worm its many other virtues are neglected. The seed of this plant gives oil which does not get importance. It could have been useful for many use including for manufacture of soap.

Its bark is basically medicinal. Its use has recognition in ayu vedic since epic days. It has recognition in both homeopathy and allopathy alike. Powdered bark relieves hypertension, has a diuretic and a general tonic effect in case of cirrhosis of the liver. Bark considered a cardiac stimulant. It shows the presence of calcium. Isolation of arjunalic acid saponin and leucodelphinidin.

Plantation of this plant is being encouraged basically for cultivating tassar silk worms but it has more importance as a medicinal plant today in this age when cirrhosis of liver is so common due to consumption of polluted water or hypertension or cardiac diseases in the age of so many tensions.

CHAPTER 71

SISAL

Here sisal does not mean only a particular variety being called by same name but the entire *Agave* genus commonly known by same name. Various varieties are found all over India irrespective of altitudes and often being cultivated for various reasons. Sisal plants jointly known as Rambans or Rakkaspatta in Hindi and Bengali, Baramasiya pata in Oriya, Ghaipat in Marathi, Kalnar or Kattale or Rakkasbale in Kannada, Kattale or Kattavale in Tamil and Malayalam and Kabbanda in Telugu. All of them belong to *Amaryllidaceae* botanical family of *Agave* genus. Out of all *Agave* *Sisalana* Perr., is most widely cultivated while all others grow wild. Other plants are *Agave americana* Linn., *Agave Cantala* Linn., *Agave Wight* and *Agave Viracruz* Linn. Besides above a hybrid variety was developed by Sisal research station, Bamra, in Sambalpur district of Orissa. Commercially this variety is known as Bamra bun.

The Sisal or agave is a large genus of short stemmed half woody plants bearing rosettes of long, erect, pointed, fleshy leaves. These leaves yield a valuable fibre. The strands of the fibres lie embodied longitudinally. These plants have additional qualities of conserving soil characteristics and yielding various important organics.

It is a native of Mexico and other parts of the caribbean area. The plants were taken from there to Europe, Africa and the far East by the Spanish and the Portuguese. They were perhaps introduced in India by the Portuguese some time during fifteenth century. They are naturalised wherever they were taken. It is reported that Mayans propagated this and a part of Maya economy depended on products from Sisal of various varieties.

There are about 275 species of them. They are characterised by their fleshy rigid hard surfaced, lanceolate leaves growing directly from the centre of the stalk to form dense rosettes. In some species the stalk is very short. In some it rises to a height of 3 metres or so. The leaves range in length from few centimetres to one to two metres, with a width upto 7 cms at the base and 10 to 15 cms at their widest point. In cross section they are concave. In some the edges have sharp spines or thorns. Some have clean edges, but end in a dagger like spine. The leaves are bright green in colour. They spring from the top of the stem and grow vertically. As their growth progresses, they are pushed aside by newly emerging leaves. The older leaves then take a sloping position. The colour of leaves of cantala variety is lighter than the other and its surface is smoother. When the leaves stop growing, the first formed leaves are almost horizontal. The plant has then 200 to 300 leaves, if of course, they are allowed to grow and not harvested.

Sisals flower from 4 to 20 years after planting, for the first and the last time. A central flower stalk is then sent out and dense clusters of flowers appear on branches growing out from it. The appearance of the stalk is an indication that the plant is nearing its end. When the flowers bloom and seeds grow from them, the old plant dies. Seeds then begin to fall down to the ground where they germinate and take root.

Sisals are hardy plants. They are unique in hardiness. They grow well in practically every tropical or almost tropical climate with moderate humidity, and in almost any kind of soil. They possess enormous vitality, and brave many many hardships. They carry with them their own defence, namely, the spines and spikes and survive almost every calamity. Cattle do not attack them. Diseases and insects do not harm them.

They grow best in warm and rather arid regions. Some variety thrive well on well drained, rocky soil. Stony disintegrated lime rocks are better suited for them. Others, particularly the cultivated varieties give better results on moderately rich well drained soil. The plants in either case are very frugal in their demands. Areas with 30 inches of rainfall do very well. These conditions are found in many parts of the world and consequently growing of Sisal has spread

enormously. The length of life also depends on the soil and the climate.

The propagation of the plant is either by means of the bulbils or by the rhizomes sent out by the mature plants. These are usually planted in nurseries. When the suckers are a year or a year and a half old, they are transplanted into the field. Planting is done just before or at the beginning of the rains. The distance between the two plants should be one to three metres. They are usually planted in rows of three to four metres distance. The distance between the rows can be less say one to three metres. But in large plantations the movement of vehicles become difficult when it is less than three metres.

The method of cultivation vary depending on the soil and local custom. Cultivation and weeding on well kept plantations are done every three or four months during the first two years. Thereafter they need be done only once or twice a year. Few diseases and insect attack the plants. In well kept plantations cover crops are frequently planted.

Of the numerous species four are common in India such as *Agave sisalana*, *Agave cantala*, *Agave veracruz* and *Agave wright*. Out of these *Agave Sisalana* is only variety that is planted or cultivated while all other usually grow wild except very few exceptions. However none of them are cultivated commercially. They either grow wild or are cultivated as hedge plants to protect crop against animals, to protect canals and railway embankments. In recent times they are planted increasingly to prevent soil erosion. Development of "Bamra bun" variety is a recent one and its popularity still to pick up.

This plant is cultivated commercially specifically because of its fibre. Fibre yield of various spaces found in India are given below.

<i>Species</i>	<i>Percentage of fibre</i>
Sisalana	4 to 4.5
Veracruz	3.5 to 4
Cantala	3.4 to 4
Bamra bun (hybrid)	4 to 4.5

(Source - ICAR, Bamra)

Commercial cultivation was tried only in few pockets. It will be unfair on my part if I do not mention the contribution of two Irish sisters commonly known as Kaycae sisters who first commercialised Sisal in their farm at Nildongri a few kilometers from Sambalpur in Orissa perhaps some time during early thirties. They cultivated *Agave Sisalana* in about 1500 acres of land in Nildongri and Beldongri the two adjacent villages. They showed the way to extract the fibre twisted then into ropes and sold commercially. The farm is still in existence but under administrative control of Asst. Soil conservation Officer, Nildongri.

Apart from the fibre the leaves of all the varieties of sisal contain a steroid, sapogenins, hecogenin. Hecogenin is an important product, since it is used for making cortisone and material for manufacture of sex hormones. *Sisalana* variety yields 2.3 g per kg of leave. Leaves of *Agave americana* yield 0.065 per cent hecogenin while cantala variety yield 0.15 per cent. Yield of hecogenin in Veracruz and bamra bun varieties are almost in the order of cantala. It is all the more encouraging to note that hecogenin can be extracted from the wastes after extracting fibre. Leaves of Cantala also contain Saponases suitable for conversion of *Dioscorea* saponin to diosgenin.

Nevertheless fibre remained the main product wherever Sisal is cultivated commercially. To this date the fibres are extracted by water retting in most of the areas. The methods are similar to those employed for jute as discussed earlier, and then sun dried. While in some areas the whole leaves are soaked in water in some they are split into strips and then soaked or retted. In some other areas the leaves are beaten or pounded with mallets by placing them on a stone and then retted. Both of these processes accelerate the pace of retting. In some areas the leaves are crushed in mills of the sugarcane crusher type and retted thereafter. This last named process removes the sap responsible for bringing about the harshness and the brittleness of the fibres and in addition separates the individual fibres to some extent. The retting is done in ponds or tanks where water is stationary. Leaves are weighted with earth or stone etc. The method discolours the fibres and in addition makes them weaker. The fibres do not become detached completely and hence they are either pounded once again or hackled.

In some parts of India the leaves are scraped with knife of a somewhat blunt edge or a piece of bamboo with a sharp edge. This gives a superior fibre. But the process is a very slow one which either makes the price prohibitive or the artisan does not get appropriate wages. Besides only the tender leaves can be treated in this way hence we get weaker and the fibres of short length. A mere wash thereafter becomes sufficient to remove gums from the fibres. This method however still being followed in interior places in Koraput or Mayurbhanj districts of Orissa as a part of Bonda and Lodha micro project to produce flowers for bicycle wheels and decorative items of similar nature.

All these operations must be done promptly after the leaves are cut. Otherwise the gums in the leaves harden causing the pulp to adhere to the fibres. Thereafter the cleaning of the fibres becomes practically impossible.

These processes for the recovery of the fibres from the leaves work very well in areas where the labour is plentiful and cheap, where the water supply is abundant and the quantities of leaves to be operated are small. But if such situation is not available, the entire operation shall fail. There is another major disadvantage too. By following above methods, it will be impossible to extract hecogenin even if we want to.

This is one of the reasons why the industry did not make much head way till the beginning of this century. The credit for its progress goes to a Spanish Franciscan Friar who invented the raspador in the last decade of the 19th century. The first fairly successful machine was of a portable type. It was patented in France in the year 1896. Since then a large number of machines were designed based on same principal.

In India Khadi and Village Industries Commission took initiative for developing industry based on Sisal and recognised a few firms manufacturing raspador machine. In addition a number of firm has also manufactured such raspadors according to local conditions, but yet to be recognised. It is these firms who are responsible for development of raspador based Sisal industry in India.

The principal of the raspador consists of first crushing the leaf and then holding it by mechanical means against the scraping action of blades set at intervals on the outer circumferences of a

rotating drum. The tip end of the leaf is inserted first and the fibre freed for about half the length. Then the leaf is pulled from the machine. The other end of the leaf is then fed into the machine until the remaining length of the fibre is freed when pulled from the machine. The blades scrape away the cellular tissue from the fibres. The leaves are scraped in both ways. The fibres are then washed to remove any pieces of pulp remaining on them. In the process, large quantities of water are added to facilitate the removal of flesh, not only to remove the small fleshy particles and the gums from the fibres, but also to carry away aggressive acids of the plant and the considerable quantity of waste material produced in the course of the process. The loss and damage of same quantity of fibres in this or in any process is inevitable, but in the best of the machines, they are kept at a minimum. After washing the fibres should be dried, either in the sun or in mechanised driers. Cost of drying operation or time taken for drying can be minimised if the fibres are squeezed mechanically before drying when dry they should be brushed against a drum.

A modern hackling machine was also developed to increase the speed of production after retting. But retting and hackling method of extraction of fibre shall remain disadvantageous position since all other virtues are usually lost or degraded.

In raspador system we get waste material at two stages. First while extracting fibre using a raspador when we get more of solid particles of the leaves other than the portion of fibre that is taken out. Second while washing the fibre when we get rather diluted waste mixed with water. The first stages waste is obviously more useful from which its juice is squeezed out followed by a wash under controlled condition so that the lye is taken out for extraction of hecoginin. Then rest of the solid may be taken to pulping beater mixing the liquid waste at second stage, ultimately to produce paper or paper board. Hecoginin, has to be isolated as early as possible to prevent auto oxidation. The leaves also contain wax which can also be extracted at some stage.

Sisal is now the world's most important leaf fibre constituting more than half the production of all leaf textile fibres. The success or failure has resulted in a large measure from the fact that

the fibre can be machine decorticated. In order to produce the fibre on a commercial basis, however, it must be grown on compact areas of not less than 150 acres. For extraction of hecoginin we perhaps need a larger area of cultivation. If all the virtues are effectively utilised the project bound to become highly commercial.

Sisal fibre has very good strength and elongation properties. It is also extremely cheap. Hence it become extremely popular as a cordage material and textile fabric. It offers very good resistance to micro Organisms found in the sea water. Hence it serves very well for the manufacture of marine cordage. It is used principally for ropes and twines for agricultural, Marine, tying, wrapping and general industrial purposes. It is estimated that more than 95 per cent of the world's binder twine is said to be made from Sisal. Many utility goods such as brush were, ladies bags, cheap varieties of door mats, carpets, fibre belting, brooms and high class paper are also produced out of sisal. In recent years it has also being used for the manufacture of coarse fabrics like hessians, sacking, rugs and other forms of floor covering. Woven sisal fibre can be successfully resin moulded to produce many utility items like furnitures and fixtures, brief cases or suit cases, wall decorations etc., and if more tensile strength is needed it can be moulded with fibre glass. Sisal fibre was also used successfully as chappal upper replacing leather hence it reduces the cost of footwear.

Sisal is cultivated commercially in many countries like Tanganyika, Mexico, Brazil, Kenya, Cuba, Far Eastern countries, Angola, Venezuela, Zimbabwe and so on and are world leaders in Sisal fibre production too. Till recently Sisal grew in India scattered manner but it is now being cultivated compact manner in many of our states particularly to prevent soil erosion. To be specific it is being cultivated in Maharastra, North Eastern States and Orissa. In Orissa many persons have taken up Sisal cultivation commercially to produce Marine rope. In Samabalpur and Sundergarh districts a number of small scale Industries are thriving on Sisal rope economy. Soil Conservation Department, Government of Orissa has cultivated Sisal in 4408 hectares of land in various districts. Area brought under Sisal cultivation in various districts are 935 ha, 552 ha, 199 ha,

1228 ha, 188 ha, 774 ha, 22 ha, 366 ha and 144 ha in Sambalpur, Bolangir, Phulbani, Koraput, Keonjhar, Sundergarh, Cuttack, Kalahandi and Mayurbhanj respectively. This is over and above commercial cultivation private firms and wild growth of various varieties of Sisal. ICAR has a Sisal Research Station at Bamra in Sambalpur district and its Scientist incharge Sri Kishen Singh is doing excelent work on growth of Sisal based industry. Soil conservation Department is also having a number of Centres for extracting the fibre. The latest variety of Sisal, Bamra bun not only gives more percentage of fibre and hecoginin per leaf but each plant gives more number of leaves. This need to be propagated to make sisal plantation and production of various products more acceptable economically.

Target of Sisal cultivation and utilisation of its virtues got to be changed to make it acceptable to all and its propagation shall not only give us various products but shall conserve our soil to give us an environmentally clean societv

CHAPTER 72

CASTOR

Almost all the worlds ancient civilisations knew the use of castor oil particularly as purgative. It is believed that this plant is a native of North India, particularly arounds Tarai. Some persons believe that it is a native of Africa. However it is immaterial now since, what is more important being its utility. In botanical nomenclature it is called *Ricinus communis* Linn., and belong to Euphorbiaceae botanical family. In English it is called Castor, while it is known as Redi in Bangali, Jada in Oriya, Erand in Hindi and Marathi, Era in Assamese, Divaligo in Gujrathi and Haralu yenne in Kannada. India, USA, China, Italy, Africa and various South American countries are its prominent growers.

There are eight varieties of Castor found in India, classified according to its seed. "Chittu" variety has a small seed with less oil and grown in Tamil Nadu, Andhra Pradesh and Madhya Pradesh "Kalhiwar" variety yields less oil having small seeds and are grown in Gujrath. Madra variety has medium sized seeds yielding less oil and are cultivated in Andhra Pradesh and Karnataka. "Hyderabad" variety has medium sized seed yielding plenty of oil. This variety is cultivated in Andhra Pradesh and Madhya Pradesh. "Gujrat" variety has medium sized seed yielding less oil and are cultivated in Gujrath. "Calcutta" variety has big seeds yielding plenty of oil. This variety is grown in Bihar, Orissa and West Bengal. "Salem" variety has big coloured seeds having medium oil content and are grown in Tamil Nadu and Karnataka. "Kanpur" variety is grown in Uttar Pradesh and Maharashtra and has big seeds.

Seed, more precisely its oil is the principal product. Hence the cultivation, harvesting and other agricultural operations are

planned accordingly. In many states as a Kharif crop, the Castor is sown in June to August and harvested in November to March. In Karnataka the seed is sown in April and harvested during the months October to November. In Eastern India Particularly Bihar and in Maharashtra, as a Rabi crop it is harvested in April/May.

Castors leaves are believed to be medicinal but its virtue is yet to be analysed. It is however a good feed for Endi Silk worms. Bark is good for gums and teeths and often used as a part of tooth paste or powder preparations. Stem itself is used as tooth brush.

Castor seeds have proved to be a boon in curing, paralysis, rheumatism, artharitis, lumbaga and hemocramia. On an average the seed yields 35 to 55 per cent oil depending on the variety as stated earlier. The properties of Castor oil is given below.

Properties of Castor oil

Specific gravity at 15°C	-	0.958 to 0.968
Saponification value	-	177 to 187
Iodine value	-	83 to 86
Titre	-	3°C
Acetyl value	-	143 to 150
Unsaponifiable matter	-	0.3 to 0.5%

Fatty acid composition of Costor oil is given below

<i>Fatty acid</i>	<i>Percentage</i>
Ricinoloic	86.0
Oleic	7.0
Linoleic	3.5
Stearic	0.3
Hydroxy Stearic	1.8

The oil is basically viscous, pale colour having good characteristic fragrance. It can not be used as edible oil but can be used as a purgative only. It is extremely good as a hair oil as it helps in growth of hair. It was traditionally used as fuel for oil lamps, since it burns for longer period. During second world

war this oil was used to clean aeroplanes. Back home, since this oil is highly viscous and sticky, it is often used for coating iron implements during storage to prevent rusting. Castor oil is mixed with Sulphuric acid to prepare Turkey red oil which is used in dyeing industry. Castor seeds ground into pulp with Sugar and milk and soiled into a semi solid is often used as traditional medicine that relieves arthritis and rheumatism.

Castor oil is commonly used as a part of formulation for manufacture of soap. But it creates problem at the time of graining. The lye and the soap tend to form a unseparable emulsion due to the presence of Castor oil. Attempts are made to use Castor oil after hydrogenation or oxidation but success is limited but situation improves half way through.

Castor oil congeals to a gal mass when the alcoholic solution is distilled in presence of sodium salts of higher fatty acids. The gel is useful in dermatitis and is a good protective in occupational eczemas and dermatitis. Modification of dehydrated Castor oil with styrene gives us a product that can be of many pharmaceutical and chemical use.

Castor stem and branches found to be fibrous. No attempt yet done to exploits, these fibre for various use. Even its known virtue of promoting endi silk industry by cultivating endi silk worm feeding castor leaves are not tried except in Assam part of Bihar and part of Orissa. Infact in Assam Endi is called Eri based on Era meaning Castor.

Castor oil cake however can not be used as cattle feed. It can be a good manure and can be used for manufacture of adhesives

Beekeeping industry can very well be planned during its flowering season as it has the nector.

Virtues of Castor is many, what we utilise is only a part of the total story.

CHAPTER 73

COCOA

Cocoa, the source of many beverages and sweets is believed to be a native of Central America and West Indies. But the plant was commercially cultivated first in few African countries successfully and till date Ghana and Nigeria remained as world leaders. A few decade back it was tried in India as a cash crop and now Kerala, Goa and a part of Karnataka as leading in production of Cocoa.

The leaves of Cocoa trees is basically used for green manuring Cocoa plantation itself. It is also used as animal or cattle fodder locally. The leaves and the plant itself yields essential oil.

Cocoa is cultivated basically for its seed which yields oil. The Cocoa seed is first powdered and then pressed to extract oil after heating beyond melting point of oil. Balance seed powder or oil seed is also sold as cocoa powder at a higher value. The properties of Cocoa fat is as under.

Properties of Cocoa fat

Specific gravity at 60°C	-	0.882 to 0.883
Saponification value	-	192 to 198
Iodine value	-	34 to 40
Titre	-	40 to 50°C
Unsaponifiable matter	-	0.3 to 0.8%

Fatty acid composition of Cocoa fat is given below

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	23.8
Stearic	33.8
Oleic	38.2
Linoleic	2.00

Cocoa, known as *Theobroma Cacao* in botanical nomenclature is universally known as cocoa butter is a saturated fat which remains solid at normal room temperature. It is an excellent raw material for soap but is normally not used due to its prohibitive price. It is normally used in confectionary industry only. This butter is used in different ways. Chocolate is prepared, by adding little butter to cocoa and sugar. The essential oil is cocoa butter and cocoa seed is also isolated and used in confectionary industry using other similar fats. Oil cake after extracting oil is usually powdered and sold separately, used in condiments or as a part of drink.

Cocoa is basically a cash crop hence its propagation shall take place automatically.

CHAPTER 74

PAPAYA

Papaya is now a most popular fruit as well as vegetable in India. It is believed the plant was brought to India by Portuguese and later it started growing wild. It is known all over either as papaya or pepe or in other names basically derived from the term Papaya only varying to some extent according to local language. In botanical nomenclature it is called *Carica papaya* linn., and belong to Caricaceae botanical family.

It grows tall with large leaves and fruit at the top of the plant like those of palm trees, while rest of the trunk down below remains empty. The stem or trunk remains very weak or tender all through its life span.

The leaves of papaya is reported to be analgesic and anti-inflammatory. It yields an alkaloid Carpaine which has many pharmaceutical and therapeutic use. Seeds are also analgesic and anti-inflammatory.

Unripe fruit is a popular vegetable. It is used with curry or simply as boiled vegetable. It is believed that unripe fruit is extremely useful for stomach as it helps in proper bowel movement. The milk of unripe fruit is digestive, useful for Colic and piles. It improves liver action and good for liver diseases.

Ripe fruit is an extremely popular fruit in India which is consumed raw or with fruit salad. It has sufficient sugar as fructose, vitamins A, B and C besides Carbohydrate. It is astringent to bowels and removes biliousness. It acts as mild laxative.

It is reported that latex has necessary anticoagulant properties. By purification we can get necessary extract which can be used for above purpose. It also inhibits clotting, the action

of thrombin on fibrinogen. Infact extract from any part of plant is reported to be blood anticoagulant.

The plant grows as a garden plant or as avenue plant or grows wild. One or two plants per family feeds entire family either as fruit or vegetable. Medicinal virtues are not get exploited commercially. Since the plant grows without much care its plantation should be encouraged not only as a garden plant but also commercially so that its virtues can be exploited property besides of course taking care of environment.

CHAPTER 75

LETTUCE

Lettuce leaves are commonly used as part of salad or decoration of table dishes. It is obviously edible. They are small shrubs either grown in Kitchen garden or grows wild. There are five varieties of lettuce found in India out of which one variety has Indian origin. Botanically all these varieties are *Lactuca indica* Linn., *Lactuca remotiflora* DC., *Lactuca runcinate* DC., *Lactuca Sativa* Linn., and *Lactuca serriola* Linn.

Lactuca indica Linn., has its origin in India and found commonly in Sikkim, Assam and Khasi hills of Meghalaya. Its leaves are tonic, digestive and deparative. In abor hills, the dried latex is used as a substitute for opium.

Lactuca remotiflora D.C., is also considered to be medicinal. The plant is reported to be used for chronic obstructions of liver and bowels and as diuretic in Calculous affections.

The plant of *Lactuca runcinata* D.C. is diuretic, tonic and slightly aperient.

Lactuca sativa Linn., is commonly called garden lettuce. Garden lettuce like other species of *Lactuce* yields lactucarium used as hypnotic in bronchitis and asthma. Lettuce is used in poultices for burns and painful ulcers. In nutritive value it is classed with Cauliflower, celery and asparagus, chiefly valued for its vitamins particularly vitamins E, C, K and Choline. It also contains a number or minerals.

Lactuca serriola Linn., is commonly called prickly lettuce. The seeds of this variety of lettuce yields 35.2 per cent semi drying oil, reported to possess hypnotic and antipyretic properties. The milky latex yields lactucarium. This lettuce is however is not edible.

The lettuces, as discussed above grows quickly as a garden shrub without much care. Therefore its propagation may not be difficult.

CHAPTER 76

CHANDAN

Chandan or Sandalwood tree is extremely popular not only in India but also abroad due to its sweet odour. It is known as Chandan almost in all Indian languages. In botanical nomenclature it is called *Santalum album* Linn., and belong to Santalaceae botanical family.

The small evergreen tree Chandan is available in plenty in Karnataka and are also found in Ganjam, Kalahandi and Phulbani districts of Orissa besides in some pockets of Manipur and Meghalaya. Its wood yields an essential oil and its quality depends on the altitude it grows, that is 700 metres above sea level. The yield is about 4 to 6 per cent depending on quality. By fractionating this essential oil in a packed column it yields α and β - Santalenes.

When a piece of moist Chandan wood is rubbed against a stone it gives an aromatic paste which is used in various rituals in Hindu rites. This paste is a coolant cures stomach diseases when consumed and applied externally on boils, burns and cuts. It also prevents heat stroke when applied on our body. It is also used in various Ayurvedic preparations.

Its flowers also yields essential oil. It has nectar which yields honey hence beekeeping industry can be planned. Its leaves also yields essential oil.

Chandan fruits yield betulinic acid and β - sitosterol. Its seed yields 44 per cent oil while the Kernel 55 per cent. The properties of Chandan seed oil is given below.

Properties of Chandan Seed oil

Refractive index at 60°C	1.476 to 1.478
Specific gravity at 25°C	0.9356
Saponification value	185 to 197

Iodine value	138 to 153
Acetyl value	20.8 to 24.3
Unsaponifiable matter	16.8 to 18.8%

Most of the fatty acids it contains are unsaturated notably Oleic, linoleic etc. It is extremely good as a edible oil and also can be used for manufacture of soap and varnishes. It is also a good lubricant. Oil cake is a good cattle feed, manure and can be used for manufacture of industrial adhesives.

Therefore Chandan is just a sacred plant but is beyond that.

CHAPTER 77

CROTON

The plants of Croton genus are found all over India growing wild. There are three varieties of Crotons are found in India such as Croton joufra Roxb., Croton sparsiiflorus Morong and Croton tiglium Linn. All of them belong to Euphorbiaceae botanical family. Croton sparsiiflorus Morong is believed to be native of South America but was introduced and later naturalised in India.

Croton sparsiiflorus Morong, is known to yield colouring matters or dyes. Croton dye was traditionally used by the natives.

Both Croton joufra Roxb and Croton tiglium Linn are known for yielding oil in its Kernels. Joufra Kernel yields 37 per cent fatty oil while tiglium seed and Kernel yields 34 and 45 per cent oil respectively. Both these oils contains a vesicant non-purgative and a non-vesicant purgative fraction. Peeled fruits of tiglium variety contains poisons. Seeds of tiglium variety contain two tumour promoting principles.

The Kernel oil of Croton tiglium Linn are considered to be highly medicinal but not edible. It can be used as raw material for soap upto limited extent since the soap thus formed tend to become soft due to higher percentage of unsaturated fatty acids. However it can be used at higher proportion if hydrogenated. The properties of tiglium oil is given below

Properties of tiglium oil

Specific gravity at 15°C	-	0.9320 to 0.9501
Refractive index at 20°C	-	1.4734 to 1.4810
Saponification value	-	200 to 215

Iodine value	-	102 to 115
Acid value	-	2.55
Melting point	-	(-) 7 to (-) 16°C

Fatty acid composition of tighun oil is given below

<i>Fatty acid</i>	<i>Percentage</i>
Oleic	37.0
Linoleic	19.0
Arachidic	1.5
Stearic	0.3
Palmitic	0.9
Myristic	7.5
Other acids	8.3

The fatty acids can also be isolated by splitting the fat using sweet water method and hence the use of oil can be further expanded. Oil cake can be a good manure and can be used for manufacture of industrial adhesives but can not be used as cattle feed.

These plants grow wild and are subject of felling. Its plantation can be encouraged if its virtues are utilised properly.

CHAPTER 78

KHIRKHEJUR

Khirkhejur plant is commonly found as a natural plant in Central India and deccan. It is also cultivated throughout greater part of India for various purposes. It is called Khirmi in Hindi, Ranjana in Marathi, Khirakuli in Oriya, Khirkhejur in Bengali, Palla in Tamil and Malayalam, Bakula in Kannada, Rayan of Khirmi in Gujrathi and Majipala in Telugu. In botanical nomenclature it is called *Manilkara hexandra* Roxb., or *Mimsops hexendra* Roxb. It belong to Saptaceae botanical family.

Almost all part of this plant is believed to be medicinal. Particularly the bark is used in fevers and as a general tonic Fruit yield various saponins and alkaloids used for various purposes.

Seeds yield 24.6 per cent oil while the Kernal yields 47.2 per cent. The properties of Khirkhejur oil is given below.

Properties of Khirkhejur oil

Specific gravity at 15.5°C	-	0.936
Refractive index at 60°C	-	1.428
Saponification value	-	190
Iodine value	-	65.3
Acid value	-	1.29
Unsataponifiable matter	-	1%

Fatty acid composition of Khirkhejur are Palmoitic, Stearic, Lignoceric, Oleic, and Linoleic of 18.8 per cent, 14 per cent, 1.1 per cent, 62.5 per cent and 2.7 per cent respectively of the oil.

The oil is an excellent edible oil more so because it is unsaturated. The oil is also demulcent and emollient.

After extracting oil what remains is oil cake. Oil cake can be used as cattle feed, manure and for manufacture of adhesives.

Cultivation of this plant can be taken up firstly, because of its virtues particularly for edible oil.

CHAPTER 79

LAVENDAR

Lavendar is native of Central Europe and the plant is basically popular and cultivated for its essential oil. It is now being cultivated in colder region of India precisely for same purpose. There are a number of species found in India of *Lavandula* genus, a few of them were already existing as a local plant. They all belong to Labitae botanical family. The essential oil is extracted from its blue, flowers.

Out of all species *Lavandula Vera* Linn., is mostly widely cultivated. This lavender is comonlly known as True Lavendar or common lavender. The yield of essential oil in this species is highest hence commercially preferred. *Lavandula Spica* Loisel, yields a similar oil but yield is less. Advantage of this plant being it does not need much care for its growth and grows quickly. Other plants reported to give similar aroma, but with lesser yield of essential oil are *Lavandula officinalis* Chaix. and *Lavandula angustifolia* Mill.

Lavandula Stoechas Linn. commonly known as French lavender is slightly different from all other species described above. Its odour is also different. Its essential yield is 0.75 per cent of story Camphoraceous odour. Oil of stoechas variety is prescribed in colic and chest affections and for relieving biliousness and nervous headaches. It is also reported to be moth repellent. The flowers are used for fomentation to relieve rheumatic and neuralgic pains. Fresh or spent flowers are used for medicated pillows and cushions. Flowers are also used as perfumes, herb sachets and in fumigating powder.

Cultivation of this plant genus should be propagated not only for its sweet aroma but also for medicinal value. The essential oil of these plants are used for various purposes particularly in soaps and cosmetics.

CHAPTEK 80

GROUNDNUT

Groundnut is known as China badam in Bengali or Oriya, Mungphalli in Hindi, Bhui, Bhuimugchana in Gujrathi, Bhuimug in Marathi, Nekadle in Kannada and Groundnut or Monkey nut in English. In botanical nomenclature it is called *Arachis hypogaea* Linn. It belongs to leguminosae botanical family.

It is believed that, this plant is originally the native of Brazil and was perhaps brought to India by Portuguese in the Western Coast notably Kerala coast, Goa and Maharashtra. However it has now become a world phenomenon being cultivated in all the continents while India being the world leader followed by China. However, yield per unit area is one of the lowest in India and highest in China.

Groundnut is a rotation crop. This peculiar plant lives only for one year. As such every year new seed has to be sown.

Flowers do have the nectar. Hence beekeeping industry can be planned on this plant. After fall of the flower, the seed cell is produced. Afterwards, the twig having the seed grows long and bends forward towards the ground. Then in order to fully ripen the seed, this twig enters the soil and hides there. Perhaps due to this reason, the seed has acquired the name of "Groundnut". The ripened groundnut is removed from the soil and dried.

There are various varieties of this oil seed. This variation depends on the shape of the oil seed, form, size and on the oil content of the seed. Above all, it also depends on the thickness and weight of the outer coat. Also the size and number of Kernel in the nut is a factor to decide the variety. The colour of the seed Kernel indicates the bifurcation of the variety. Commercially following varieties are grown in India.

- (a) Coromandal variety
- (b) Bold variety
- (c) Pea nut variety
- (d) Red natal variety
- (e) Khandesh variety
- (f) Ak - 10 variety
- (g) Verg nia variety
- (h) Superior Bold Kerad variety

In addition Bhaba Atomic Energy Research Centre has developed a hybrid variety which gives about 40 per cent oil above traditional crop

The plant dies after one year and is used as green manure for next crop Both nut and the oil is edible. The nut contains aflatoxin and its constitution is leucocyanidin. Subcellular fractions of the seed contains protein. The nut itself contains high percentage of protein

On an average the seed yields 40 per cent oil while Kernal yields 50 per cent. Oil is a popular edible oil used as raw, refined or as part of hydrogenated fat It is also used as part of soap formulation Hydrogenated ground nut is used in the formulation of Glycerine soap since it brings the required transparency The properties of Ground nut oil is given below :

Properties of groundnut oil

Colour	-	Pale yellow
Consistency	-	Liquid
Odour	-	Typical fragrant oil
Specific gravity at 15°C	-	0.911 to 0.926
Saponification value	-	193.5
Iodine value	-	91.5
Titre	-	25.5°C
Unsaponifiable matter	-	0.5 to 1.0%

Fatty acid composition of ground nut oil is given below

<i>Fatty acid</i>	<i>Percentage</i>
Palmitic	7.3

Stearic	5.5
Arachidic	3.6
Lignoceric	2.9
Oleic	56.7
Linoleic	23.1

The oil being unsaturated is extremely good for health.

Traditionally the oil cake is fed to cattle. But pressed oil cake can be consumed also. Pressed cake pellets yields the alkaloid arachine and impure choline. The cake also contains protein which can be extracted. An artificial thread called "Ardil" is drawn from the cake which can be woven into fabrics mixing with cotton, woollen and rayon. Cake also can be an excellent raw material manufacture of industrial adhesives. Nowadays milk, curd and butter are prepared from groundnut.

Groundnut, nuts are very popular food. It is extremely good diet for the persons having low pressure and those having constipation since it has high protein and helps in bowel movement.

Therefore it is an excellent plant for cultivation that assures us better health and environment.

CHAPTER 81

BUTEA

Butea genus belong to Leguminosae botanical family. There are a number of species of butea genus found in India out of which Butea Frondosa Koen., and Butea monosperna Lam., preported to be most common.

Leucocynictin reported to be found in the gum of this plant. It could be isolated in laboratory scale.

The flower of this plant do have nectar. Hence beekeeping industry can be planned based on this plant. The bark of the plant gives a very crude fibre which is yet to be tried

Seed of the plant yields 18 to 19 per cent fatty oil. The properties of the butea oil is gives below.

Properties of butea oil

Specific gravity at 30 ^o c	-	0.9076
Refractive index at 30 ^o c	-	1.4791
Saponification value	-	184 to 185
Iodine value	-	85.1
Acid value	-	1.89%

Fatty acid composition of butea oil is as under

<i>Fatty acid</i>	<i>Percengate</i>
Palmitic	21.2
Stearic	9.1
Arachidic	6.0
Behenic	5.7
Lignoceric	4.4

Oleic	29.9
linoleic	25.7

This oil can be an excellent raw material for soap. If the individual fatty acid be isolated, they can be used of various other purposes besides yielding all important glycerol as by product.

Seeds reported of contain three alkaloids toxic to earthworm. Ether extract yields very active products perhaps a phenolic compound containing nitrogen.

Oil cake cannot be used as cattle feed but can be used as manure. But excessive use may kill the all important earth worms, can be used for manufacturing adhesives.

The plants grow wild and scattered. That is precisely the reason why its virtues can not be utilised commercially.

CHAPTER 82

JAMUN

Jamun is one of the most popular edible fruit growing wild all over our country. It is called Jamun, Jamu or Jam in various Indian languages, the term basically derived from Jamun. In botanical nomenclature it is called *Syzygium Cumini* Linn. and belong to Myrtaceae botanical family.

Fruit of this plant is edible not only because of its taste but also improves liver functioning. It is also coolant, digestive and good for stomach. The drug used in the treatment of diabetes mellitus is present in its pulp.

Flowers give three triterpenoids. It does have nectar, hence beekeeping industry can be planned during its flowering season.

The bark contains 10 to 12 per cent tannins. Hence it can be used for vegetable tanning of leather. It also contains gallic acid, resin, starch and proteins but no alkaloid or glucoside. Therefore it can be used for preparation of vegetable dyes, adhesives besides for various purposes in Chemical industry.

Seeds also contain 19 per cent tannin. Hence this can be used for tanning leather. It also contains Glycoside jambolin, ellagic acid besides Gallic acid, Chlorophyll, fatty oil, starch, resin, sugar and traces of oil. Effective hypoglycemic principle extracted from dried seed with 95 per cent alcohol.

Hence this is one of the most useful plant if exploited and is much beyond merely an edible fruit yielding plant.

CHAPTER 83

MULI

Muli or Mula is one of the popular vegetable in India. It is called Radish in English, Mula or Muli in almost all Indian languages and Mulo in Bengali. In botanical nomenclature it is called *Raphanus sativus* Linn, *Raphanus malaka* linn and *Raphanus candatus* Linn. It belongs to cruciferae botanical family.

Almost all part of this plant is edible. Leaves and stems together is consumed either after frying or as other vegetable preparations. Root is basically known as muli or radish is one of the popular edible product. It is consumed raw as side dish. It is also consumed as part of salad besides consumed after cooking as part of curry. The small slices of radish root is also used with mummura or other evening snacks.

Flowers do have nectar hence beekeeping industry can be planned in the area where radish is cultivated. The flower is also consumed with the plant and are cholagogue.

The juice of green radish root removes ear ache when applied locally. The root is anthelmintic, useful for piles, dropsy, inflammation and diseases of heart. From violet red variety root cynin can be isolated. From yellowish red variety pelargonin can be isolated.

The pigment, the colouring matter of the whiplike purple coloured that are found in the edible part of the plant is malvin Chloride.

Muli can grow well in our kitchen garden besides ofcourse as mass cultivation without much care.

CHAPTER 84

SULAKHSANA

One of the most popular medicinal herb that acquired global popularity is ginseng. It is believed that this plant is the native of China and Japan and even today, China is the major supplier to the world trade. Even India also imports the root of this plant. But in our tradition texts this plant has been frequently referred to as Sulakhsana and it is reported that it grew wild in North Eastern India, West Bengal and Himalayan tract including Sikkim. Commonly known as Chinese ginseng or Asiatic ginseng, it is known as *Aralia quinquefolia* Decne and Planch or *Panax ginseng* C.A. Mey in botanical nomenclature. It belong to Araliaceae botanical family.

Roots of this plant yield 0.1 to 0.2 per cent Choline by weight and β - sitosterol. Roots also contain essential oil, resin saponin and a bitter principle. It is a tonic, stimulant restorative, alternative and demulcent. The drug stimulates central nervous system and respiration, which is ascribed to two glucosides, panoxacid A and B. Besides above an alkaloid, Vitamin-B Complex and steroidal hormones could be isolated.

It is used as tonic and in rejuvenation preparations. These properties have cosmetic applications.

Since this plant grew well in India since epic days, there is no reason why it can not be grown today. It is a small shrub and can be grown well in adequate cares are taken and appropriate conditions created. However it should be noted that to get right quality of herb to produce right quality medicines sufficient care to be taken.

The plant is usually propagated through its roots. If cultivated it gives sufficiently high return and is commercially encouraging. Cultivation of this plant shall assure us better health, better environment and better economy.

CHAPTER 85

HARITAKI

Commonly called Haritaki in Sanskrit as well as in most of the Indian languages but also called Harir, Hirda, Kaddukkai, Karitaki, Katukka and Hilikka in many other is a evergreen plant that grows upto 25 to 30 metres. It is called *Terminalia Chebula* Retz , in botanical nomenclature belonging to Combretaceae botanical family. It grows wild in plenty in Central India, North Eastern India, Orissa, Bihar, Deccan, South India and West Bengal.

The plant is normally evergreen but fall of leaves are noticed during the month of March or April and new leaves appear immediates after. Flower appears in bunch around a flower stick of 10 cm long. Fruit appears during November/December and automatically falls on maturity and are collected from the ground. The fruit is normally used for two hides.

During its flowering season it is an excellent plant for implementing beekeeping programme since the flowers do have the nectar. Haritaki honey is extremely good for health not only because of mineral and vitamin content but also because of mineral and vitamin content but also because of appropriate L/D ratio.

The fruit pulp contains sufficient tannins, polyphenolic compounds like Chebulinic acid, Chebulagic acid, gallic acid, Corilagin besides a number of phenolic constituents. It also contains anthraquinone dye stuff.

According to Atharva Veda, the fourth of the Indian ancient Vedas mentions that if haritaki pulp is taken in different proportion round the year, doses prescribed according to position of the Sun, the person remains diseases free and healthy. Haritaki is one of the reason for person living more than

100 years remaining strong and healthy during ancient days. About 3 to 5 grams of dried Haritaki pulp if taken with diluted curd and rock salt cures piles. Dried Haritaki powder when smoked in a pipe relieves asthma. It has capacity to cure dermatitis, throat diseases, hyper acidity and eye diseases and controls the growth of cancer. It is effectively used for dressing wounds and ulcers. Use of Haritaki as herb should not be given to pregnant women, physically weak persons etc.

Seed of Haritaki is edible but does not have medicinal value. However it has protein and carbohydrates. It yields 36.4 edible oil. Properties of Haritaki oil is given below.

Properties of Haritaki oil

Specific gravity at 25°C	-	0.9131
Refractive index at 25°C	-	1.4700
Saponification value	-	190.2
Iodine value	-	105.1

The composition of fatty acid of Haritaki oil is given below. It contains oil 18 per cent saturated fat.

<i>Fatty acid</i>	<i>Percentage</i>
Oleic	59
Linoleic	23
Saturated(Total)	18

The oil besides being used as edible oil it can be used in soap formulations and cosmetics upto certain proportion. It can be used in soap at larger proportion if hydrogenated. By splitting the fat we can get individual fatty acids notably Oleic which can be used for various purposes.

Haritaki grows wild but its plantation is not encouraged. We must encourage it for further interest.

CHAPTER 86

KALAMBI

Kalambi is a creeper commonly found in the area where rainfall is considerably high with fertile soil like West Bengal, Bangladesh, North Eastern India (except hill areas), a part of cow belt particularly Gangetic plains and Deccan. It is known as Kalam Sag in Bengali, Hindi and Oriya. In botanical nomenclature it is called *Ipomoea reptans* Linn., and belong to convolvulaceae botanical family.

The plant yields 0.048 essential oil and total resin 7.27 per cent. In addition it contains hydrocarbons like pentatriacontane, triacontane etc., a number of sterols and fatty acids like melissic acid, behenic acid, butyric acid and myristic acid.

Entire plant is edible. It is normally consumed as side dish after frying with fatty oil or butter. However consuming this creeper during rainy season is a taboo basically because a type of worm takes shelter during rainy season in the resin cavity of this plant due to water logging condition elsewhere, and if we consume the plant we may have to consume these unknown worms also.

This creeper is considered highly medicinal in Ayurveda, and used for various diseases. It is considered antidote for opium poisoning. Many teenagers due to frequent masturbating suffers from various problems like semen secretion during sleep, lack of concentration of Semen etc. By taking two tea spoon full of the juice of Kalmi leaf with 1½ gms of Aswagandha root powder when consumed with milk solves all these problems. Few drops of the juice of Kalmi leaf given to a new born baby not only restores his sound sleep but assures his digestion and bowel movement. Two spoon full of juice of Kalmi leaf when consumed with milk prevents chicken pox. Fried Kalmi leaf

when consumed twice daily increases quantum of milk in nursing mothers breast. It is extremely useful for venereal diseases. It relieves bee and other insect stings.

Besides being edible and medicinal the Kalmi creeper also yields fatty acids and resin. They can be solvent extracted and used as raw material for soap and cosmetics. The stem also yields a weak fibre which can be used for manufacture of various items.

The creeper is grown either in the kitchen garden or grows wild. We must not only continue to propagate as before in our kitchen garden but also should be commercially cultivated considering its virtues

CHAPTER 87

BASTUK

Most ancient literary creation of the world is Rigveda. In its stanza no. 6/24/4 it describes a small plant appreciating its virtues of winning over the diseases and bringing back the strength and beauty of human body. Not to speak of Atharva Veda which explains its medicinal virtues more in details.

The entire plant is edible and known as king among the Sags. It usually grows wild more as a weed in wheat or burley field and since agricultural land is called Bastu, this plant is known as Bastuk. It is also called Kang Kaillang in ancient texts. It is also known as Jwaragni since it has capacity to cure Jwar or fever. In Eastern India it is called Beto Sag while in cow belt it is called Job Sag. There are three types of Bastuk found in India. Most commonly used for medicinal purposes bears the botanical name *Chenopodium album* Linn. The second variety whose leaves are usually reddish bearing botanical name *Chenopodium purpurascens* is used generally for edible purposes. The third normally called Chandan Bastuk bearing botanical name *Chenopodium amboisioides* Linn which was originally the native of American continent. All of them belong to *Chenopodiaceae* botanical family.

The first variety of Bastuk that is the album variety yields 0.03 to 0.04 per cent essential oil, 40 to 45 per cent sterol viz. Ascaridol, Saponins, Vitamins such as carotene and vitamin - C, and inorganic salts such as magnesium phosphate.

By consuming the entire plant in our regular diet it improves entire body system and drives out all the worms. The juice of the leaves (3 to 4 tea spoon full) when consumed with curd controls dysentery. It controls dry coughs. The plant after boiling in water and if the water is consumed thereafter improves flow of

urine. If consumed regularly the plant assures appetite. It improves liver functioning, prevents acidity, rheumatism etc. It removes stomach worms of the warm juice of the leaves is consumed. The plant after boiling with til oil and water (3 : 4), filtered and then the liquid if massaged on head removes lice and cures dandruff.

Ambrosioides also yields essential like its cousin. It also yields the sterol ascaridol, more than its cousin. It also yields a - terpinene, anisone which yields essential oil again. The medicinal properties are more or less similar to its cousin. It can also be edible at least as side dish.

Besides being edible and medicinal the essential oil can be extracted by steam distillation. This essential oil can be used as flavour for edible products and perfume for soaps and cosmetics.

The plant is basically being considered as weed or useless vegetation near much valued wheat. It is often used for green manuring wheat field and removed during cultivation. On the other hand looking at its virtues, it need to be cultivated and propagated since it answers to our health and provides us food.

CHAPTER 88

UPODAKI

This creeper is basically considered as non-vegetarian food by orthodox Hindus. It is also considered as part of the body of Hiranyakasipu the famous demon king of epic era. In many epic literature it is said that consumption of this plants causes the sin equivalent to murder of a Brahmin. Perhaps all these beliefs were born from the practice that it was originally a non-Aryan food.

This creeper is known as Upodika in Sanskrit, Puin Sag in Bengali and Assamese, Poi in Oriya and Mulpoti in various other languages. Its cousin which grow wild is called Bonpuin. Both of them belong to Basellaceae botanical family. In botanical nomenclature the cultivated variety is called *Basella alba* Linn while the wild variety is called *Basella rubra* Linn. The cultivated variety which usually grows in Kitchen garden is usually green while the wild variety is reddish. They vary considerably in taste.

The plant contains Vitamins A and B proteins of different type, minerals like Calcium and iron besides different types of fixed oil.

Entire plant with leaves cut into pieces cooked with burley and curd and then by consuming neutralises alcoholic hang over. It prevents bleeding of piles if taken with plum and diluted curd. It is an excellent medicine to cure tumour and pimples when its juice is applied externally. It cures whooping cough if consumed with goats milk. It cures urticaria when its juice applied externally. The ash of the plant has various medicinal uses too. Its can be used a tooth powder to cure many diseases of tooth and gum. The ash when applied externally with coconut oil cures eczema. It is useful for venereal diseases and various other minor and major diseases.

The creeper is still being grown in our Kitchen garden but having good scope for growing commercially since it is even today a popular vegetable. But its medicinal virtues are still unknown. If this can also be exploited properly its commercial value shall rise many fold and become a money spinning plant.

CHAPTER 89

GRISHMA SUNDARAK

This another edible vegetation. The entire plant is consumed and is considered as one of the vegetable considered in Sag category. It is a small shrub that grows wild on the field along with grass or crops, near the bank of ponds or tanks. It is popularly called Gime Sag in Bengali, Pita gaham in Oriya, Dhime in many other languages while is known as Grishma Sundarak in Sanskrit. There are about 5 to 6 species of Mollugo genus found in India known by same Indian name all belonging to Ficoideae botanical family. Most commonly found out of all species are Mollugo opositifolio Linn., Mollugo lotoids Linn and Mollugo pentaphylla Linn. The first one is identified as Grime the second is Kakdime and the third is known as Jalpapda or Jwarpapda. All these have almost similar uses be as edible plant or as medicinal herb.

Leaves of these plants, particularly of *opositifolia* species by ethanolic extraction yield spargulagenin A, a saturated triterpenoid sapogenin trihydroxy-Ketone. The plants yield 0.038 per cent alkaloids, highly essential oil various glucosides fatty acids, saponins and vitamins, particularly carotene.

The plant in its growth and survival is different from others in the sense that in accute summer when heat of the Sun is extreme in tropical countries all other plants either die or survive with difficulty, this plant dazzle as if spring season is approaching. Not only by its look or way of survival there is similarity in its deed also. It brings back and maintains the dazzle of our skin when consumed regularly by maintaining normal liver functions. Infact the triterpenoid Spargulanin A acts well to combat many of our diseases.

In our ancient epic literature this plant is described as

Agnuddipak, Kostha suddhi-Karak, and Bisha dosha nashak, meaning bringing back fire, assuring bowel movement and antidote for poison respectively. First to properties can be assured if it assures proper liver function.

In spite of having bitter taste it is considered edible as a part of side dish. It is also taken after frying being dipped in ground lintel slurry like pokouda. Even by taking such a way also its food value remains upto desired extent hence by assuring it in our regular menu card we also assure our proper liver function.

The leaves of this plant is used for fomenting eye in case of eye irritation and its juice often used as eye drop. A spoon full of juice of its leaf when consumed with juice of amla, relieves hyper acidity and vomiting almost instantly. It very effective for eczima and skin diseases when applied externally. Its root with black pepper applied externally on both small pox and chicken pox. According to Hindu science of medicine, human body consists of Rassa (Juice), Rakta (blood), Mangshe (Flesh), Med (Fat), Asthi (bone), Mazza (marrow) and Sukra (Semen). These are collectively called Sapta dhatu. According to Charak the great doctors of ancient India, Grishma Sundarak is called Saptala since it ensures preservation of Sapta dhatu, when consumed regularly.

Not only its medicinal virtue it has other virtues too. Its essential oil can be extracted and used in soap and cosmetics industries. It can also be used a flavour since it is edible. The leaf extract can be used for preparation of herbal skin cosmetics. There are many more.

The plant still grows wild even though popular as edible plant besides being medicinal. It can be cultivated even in fallow land where no other crop can be grown and can be grown even when there is accute heat.

By propagating it will assure us many smile.

CHAPTER 90

TWASTREE

Twastree is creeper grown all over India since epic era as a garden plant not only for its beauty but also as a source of medicine particularly for stomach diseases. In epic literature it is referred as Twastree or sometime as Manduck parnee. In Bengali it is called Thankuni while in Kochbehar and Assam it is referred to as Manamani. It is also called Brahmi in many places for which it is often confused with another plant also called. Brahmi in many places although the two genus are completely different

In botanical nomenclature this plant is called *Cantella asiatica* Linn. There is another plant of same genus called *Centella japonica* Linn., which is similar to the former belonging to same genus and can be used almost for same purpose, except that the leaves of the latter are smaller. They belong to unbelliferae botanical family. The former is locally known as Dhola mani or Bada Thankuni while the later is Khud mani or Chhota Thankuni.

The plant contains acids such as pefic acid, centotiic acid, centelleic acid, alkaloids such as hydrocotyline, vellarine sterols such as α - sitosterol β - sitosterol, glycosides such as asiaticoside besides resinous substances and fat. Anthrone of asiaticoside could be isolated from the plant. Presence of tannins also reported besides of course sugar in various form. A new triterpene glycoside, thankunside and a new triterpene acid thankunic acid could be isolated and identified in various parts of this plant.

The drug has weak sedative but cardio-depressant and hypotensive action. Five to Six tea spoon full of juice of the leave if taken with a cup of milk with or without sugar if taken

everyday stops fall of hair, stops excessive perspiration, takes away bad body odour and brings back sound health and brightness. Three to four tea spoon full of juice of the leaves with equal amount of raw cows milk removes constipation, various stomach diseases and cures headache. The juice of the leaves when taken with milk and honey helps to improve memory. When a child does not talk even when his appropriate age for talking is over, a tea spoon full of the leaves of the plant is boiled, cooled and given with a few drops of honey shall help him start talking. The juice when consumed for few days shall restore normal periods for women. The entire plant including roots after boiling and filtered, the water after filtration is excellent for dressing wounds or tumours and cures even after its sceptic. Alternately, the entire plant crushed into paste cooked in ghee or butter and filtered and the filtered fat can be applied on such wounds as above and dressed. The powder of stem and root after drying if taken like a snuff cheear the nose due to cold. It is even useful to the extent of curing chronic cold. The leaf boiled in water and then if this water is grugled shall cure irruptions inside the mouth. The boiled juice of the leaves filtered and taken to cure in case of fever and amoebiasis.

Besides all above there can be various other uses. The acids, sterols, alkaloids, glycosides, resins and fats if isolated can be used in various industries like chemical, pharmaceuticals, cosmetics, soap and perfumery. The plant can effectively used for tanning the hides due to presence of tannins.

The plant is certainly in asset given by the nature to India which assures us sound health joy. Let us preserve it.

CHAPTER 91

PATOL

Traditionally an wild creeper, patol fruit is now a popular vegetable all over North India, Eastern India, Western Indian and North Eastern India. It is called Patol in Sanskrit, Bengali and Assamese, Parbal in Hindi, Marathi and all over cow belt, Patila in Orisa. In botanical nomenclature it is called *Trichosanthes dioica* Roxb. It belong to curcubitaceae botanical family. Its entire plant is edible and the leaves are highly medicinal.

The Patol fruit is shaped like human eye and consumed by using it various way. After removing its seeds and pulp it can be stuffed with crushed fish, or minced meat or any other vegetable to prepare a delicious dish either fried or with gravy. This stuffed patol is very popular in Bengal known as Dorma. Patol fruit can be consumed various ways either by frying or with any other preparation mixing with other vegetables. Even sweet dishes can be prepared with patol fruit with concentrated milk and sugar. It is believed patol fruit is basically coolant and good for stomach and helps curing stomach diseases.

The various parts of this plant contains saponins, hydrocarbons like pentriacontane, sterols particularly α -sitosterol β -sitosterol, glycosides, besides small amount of essential oil and traces of tannins. Matured seed contains an unsaturated fat with fatty acid and tri-glycerides.

Infact all the part of this creeper is medicinal. Dried patol root powder is used as part of medicinal preparation to cure of the most difficult disease called ascites. Leaves of patol creeper is sold in the markets of Bengal and Eastern India as Palta. The leaves are in fact used precisely as medicine. It works wonderfully well to combat all liver diseases, chronic or

occasional hyper acidity, indigestion, skin, diseases, fever and many more. The paste prepared with fresh patol leaves and honey if taken early in the morning ensures proper functioning of liver. The leaves with stem boiled with water cooled and filtered. This water taken before lunch or dinner ensures proper liver functioning and combats acidity. It can also be used with haritaki fruit pulp or Amla fruit pulp. Infact patol leaf juice has the capacity to bring back balance of blood pressure and maintains its consistency. Leaf normally not used commonly as edible leaf due to its bitter taste but occasionally used as side dish after frying hard to remove part of bitterness.

Patol fruit is also medicinal, and used for combating many difficulties. The juice of the fruit after roasting in direct fire if applied on body removes the mark created after small pox and chicken pox upto some extent (if the skin is not totally deformed). This juice when consumed with honey cures fever with irritation in palm and foot with vomiting tendency. This juice with either honey or with til oil if kept inside the mouth for some time and thrown away cures bad odour and irritations inside the mouth. The pulp of roasted patol if used for fomenting the tumour not only relieves from irritation but helps in secreting out the pus and accumulated bad blood.

Not only as edible vegetable or as source of medicine, this creeper can also be used for growth of industry if the saponins, glycosides, sterols etc. are isolated. It can also be used in packed food industry and as part of patented herbal medicines and cosmetics. If its cultivation is propagated, return is assured even by selling the edible fruit and medicinal leaves.

CHAPTER 92

ADRAK

Adrak root is commonly used in almost all our preparations, both in vegetarian and non-vegetarian alike. The term Adrak perhaps was derived from the term "Adran" meaning humid, perhaps because it grows well in humid soil and climate. It is called Adrak in Sanskrit, Adrak in Hindi and cow belt, Ada in Bengali and Assamese, Oda in Oriya, all these terms derived from Sanskrit word Adrak. In botanical nomenclature it is called *Zingiber officinale* Rose and belong to Zingiberaceae botanical family. In English it is called Zinger.

The root and the plant contains terpenoids e.g. camphene, α -phenandrene, cineol, citral, borneol gingerol, shogaol salts such as potassium oxalate and traces of essential oil. From the plant and the root synthesis of Zingiberene is possible. New traces of components of the oil is detected. The plant is used with peppar as abortifacient

The stem reported to have contain fairly strong fibre. The fibre can be extracted by water retting and can be used for manufacture of ropes. It can be woven and moulded suitably with plastic resins, but the fibre is generally considered to be inferior

The root is one of the important spices we can not mean card in which adrak is not used for its taste. The root is preserved after drying in controlled condition and then crushed into powder which is frequently referred to in our ayurvedic text as Shunthi

The root is considered highly medicinal. The juice of the root with honey almost certainly cures cold, cough and mild fever. It has expectorant effect too. In case of loss of appetite the root chewed with rock salt before major meals almost certainly

brings back the desired appetite. In case of small pox one tea spoonful of juice of the root mixed with one tea spoon full of juice of tulsi leave (*Ocimum sanctum* Linn) is helpful. Adrak root if consumed raw with rock salt also strengthens the systems around heart. The juice of adrak root or Shunth powder if taken in appropriate proportion regularly improves the function of Kidney, even cures nephritis. One tea spoon full of shunth when consumed with hot water cures even chronic amoebiasis. The juice of the root if taken with goat milk stops the hiccup instantly. Shunth has also capacity to stop bleeding instantly if externally applied after any physical injury.

Adrak root oil has great demand in various industries since it contains various terpenoids and essential oil. Where adrak is cultivated commercially, this industry can come up well. Our such project is being planned in Mizoram where adrak cultivation is taken up well besides of the fact that adrak from Mizoram is much superior than those produced elsewhere.

Adrak is basically a cultivated crop and hence being cultivated commercially everywhere but all its virtues are not being utilised upto desired extent.

CHAPTER 93

OLABU

Olabu is a creeper normally grows on the roof of almost every thatched houses in our villages and its fruit, stem and leaves are considered as most popular vegetables. This plant gives normally two types of fruit one being round in shape which is called Lauki in Hindi, Lau in Bengali, Oriya and Assamese and Lauki almost in entire cow belt. In botanical nomenclature it is called *Lagenaria Vagalis* Seringe and belong to Cucurbitaceae botanical family. The second type of fruit is usually elongated or elliptical bearing same name in botanical nomenclature but usually called Tumba almost all over India particularly in the languages derived from Sanskrit. In Sanskrit however both these fruits are called Olabu. In English it is often referred to as Bottle gourd or Calbash gourd.

The pulp of the fruit reported to have contain Vitamin B and ascorbic acid. Kernels of ripe seed yield about 45 per cent fatty oil. Seeds are used in dropsy and as anthelmintic. The roots are also used in the treatment of dropsy. The seed oil is applied in headaches.

The fruit itself is considered as a popular vegetable. It is cooked with various other vegetables, and consumed at least as a side dish. It is also prepared as "Raita" a traditional salad prepared with curd. The skin sometimes one taken out and fried as side dish. Stem and leaves together are also consumed after cooking, popularly known as Lan sag. Lauki fruit is considered to be coolant. Fruit and the plant contains various saponins and fatty oil and fatty alcohols.

Fatty oil yielded by its kernel is not only medicinal but can be an excellent raw material for soap and cosmetics. Unfortunately the analysis of oil is not available here. Oil cake can be excellent

cattle feed and manure. Lauki flower also have nectar hence beekeeping industry can also be planned if this plant be cultivated in vines.

Entire plant is considered medicinal and can cure a number of diseases. The juice of roasted Lauki if kept inside the mouth for 10 to 15 minutes and then spit out, shall cure piarrhea. This juice is very much effective for dressing sceptic wounds. The dazzle of the skin of the face can be restored if the pulp of the fruit is rubbed regularly in the face. The juice of the petal of the Lauki flower has the capacity to dissolve the cataract of the eye if used as eye drop, at least in initial stages. Both fruit pulp and the flower are effective for many skin diseases.

In case of hyper acidity with constipation, two to three spoon full juice of roasted lauki if taken with honey is extremely effective. Juice of roasted lauki with honey in different proportions cures fever, burning sensation of the body and stomach diseases. The same juice with sugar if consumed helps combating piles. There are many more answers that this plant gives to many of our health problem.

The creeper is usually grown in our kitchen garden or on the roof of our thatched house but concentrated cultivation yet to be taken up. Even where ever it is tried, it is mainly as a subsidiary crop. That is because its virtues are not fully realised nor the any attempt ever made to preserve its virtues. We may start at least the thinking process now.

CHAPTER 94

KUSMANDA

Kusmanda is a creeper grown either on roof top or in Kitchen garden. Some time it is grown separately on bamboo frames like vines. In Bengali it is called Chawl Kumda or Chhanchi Kumda while in Hindi and in entire cow belt it is known as Petha or Bhatua. In botanical nomenclature it is called *Benincasa hispida* (Thunb) Cogn. and belong to Cucurbitaceae botanical family.

The fruit is used in Hindu ritual as a proxy for animal sacrifice before Goddess Durga or Kali. It is edible and used after cooking with various vegetables. In fact entire plant is edible. The fruit is also used for preparation of a sweet called Petha, originally popular in Uttar Pradesh but now acquired all India popularity. Preparation of petha is very simple. It is prepared after boiling the sliced deskinning fruit pulp which is then soaked in sugar solution while hot. Sugar enters inside the pulp and crystallises to form solid white translucent sweet. This sweet can be kept for several days and can easily be transported.

The fruit pulp yields vitamin B in a high proportion. Its seed yields a fatty oil with various fatty acids and triglycscide.

The plant is propagated through seeds, usually sown just before main. The creeper grows very fast and gives the fruit within two to three months. Harvesting is done depending on end use, that is whether we need the unripe or ripe fruit. Infact unripe fruit is good for liver function semi ripe fruit is expectorant and ripe fruit has capacity to increase semen, increases sexual capacity, prevents TB and good for heart diseases.

Two to three gms of dried pulp when consumed with honey brings back memory and brings back body strength. The juice of the fruit when consumed with sugar cures pluresy. The sweet

“halua” prepared with ripe fruit and goats milk cures heart diseases particularly in case of elongation of heart. Four to five teaspoon full of juice of ripe fruit if consumed with hot milk cures bowels and ensures proper flow of urine. Juice of the fruit with sugar and milk cures TB. Pulp consumed with water after making it paste removes stomach worms.

The plant is commonly cultivated in kitchen garden everywhere but the virtues are yet to be exploited appropriately. Hence it does not have commercial importance except for manufacture of petha.

CHAPTER 95

SUNISHANNAK

Sunishannak is a common fern, a popular drug is folk medicine. The term Sunishannak is derived from original Sanskrit word Nishanna meaning sedation. Therefore when we add the word "Su" before "Nishanna", it will mean good for sedation. Therefore we may say the fern is basically used for the purpose of sedation. However, the term Sunishannak is a Sanskrit word and is not commonly used. It was various name varying from place to place. In Hindi and all over cow belt, this fern is called Chowpatia, in Oriya it is known as Sunsuniya while in Bengali it is known as Sushuni sag or Ghum Sak. In botanical nomenclature it is called *Marsilea minata* Linn. and belongs to Marsileaceae.

Leaves and whole plant is used for sedation and insomnia. It contains Saponins, nitrogenous compounds such as methylamine, mixture of normal hydrocarbons, sterols such as β -sitosterol, alcoholic constituents such as heptria-16-ol and above all Ketonic constituents such as marsiline, and 3-hydroxytriacontane. Infact it is the macrocyclic Ketone called marsiline has the maximum sedative and convulsant properties which is normally isolated for preparation of sedative drugs.

The fern usually love to live with water. Hence it develops or matures during rainy seasons. They are commonly found in the area with moist climate and grows well on muddy moist soil. They are usually absent on hilly tract. It can sustain itself even in water logged condition. As a sedative drug it has advantage over others since it does not influence cerebral cortex while acting but acts only on sub cortical stations. Therefore it does not have any permanent influence on our body as a drug nor it does have any side effect.

The leaves of this fern is edible. We often take fried leaves of this plant as side dish. In many places dried leaves are preserved and used as a input in many of our preparations. In many places infact it is a regular item in the menu card.

Medicinal virtues of this plant too many. It is extremely useful for asthma. When ever accute breathing trouble starts four to five tea spoon ful of warm juice of the leaves relieves the patient. Alternately 8 to 10 gms of fresh leaves or 3 to 4 gms of dry leaves may be boiled in 3 to 4 cups of water, filtered and if the filterate is consumed in the evening, it not only gives relieves from breating trouble but also assures sound sleep. Above prepartion is also an answer for irritation during urination. The leaf also increases memory and intelligence of child. Dried leaf may be preserved for the purpose, may be either consumed as it is or may be consumed with water or with milk or sugar. The dose prescribed is according to age subject to maximum of 2 gms per dose for as adult. About one or two spoon full of juice of the leaves cooked with ghee or butter if taken regularly helps in resting the lost memory. The juice of 15 grams of leaves boiled in water and two to four tea spoon full of this water taken with milk assures sound sleep. Raw or boiled leaf crushed with water and sugar candy if taken regularly assures stabilisation of blood pressure. The leaf is extremely useful for epilepsy. It can be applied externally for bee or insect stinges. In case of burning anssetion on the body due to nervous weakness, the juice may be applied all over the body externally before bath. The leaves and the plants are very effective tranquilizer.

The plant usually grows wild and used only as a ethno medicine, occasionally used as a side dish. It can be cultivated in otherwise neglected fallow and water logged land commercially for isolating Ketones, saponins, sterols etc., to be used as basic drug which are being important now.

CHAPTER 96

RUDRAKHSYA

Rudrakhsya has religious importance in India and garland of its seeds are worn by almost all saints of Hindu religion. It is believed that, it conveys electro magnetic influences. It is called Rudrakhsya almost in all Indian languages and is linked with many epic stories of India. It is generally believed that this plant was born from tears of Lord Shiva, otherwise known as Rudra. It generally grows wild in Nepal, hills of Uttar Pradesh, hills of Assam, North of West Bengal, Sikkim and Arunachal Pradesh. There are 90 species available in the world out of which 19 species are available in Indian sub-continent. All these species belong to Elaeocarpaceae botanical family. Most common species popularly used in India is *Elaeocarpus gantius* Roxb., while another species that grows in Indonesia often imported is *Elaeocarpus tuberculatus*. This species also grows on hills.

The fruits and seeds of this plant contain vitamins-C, citric acid, traces of fixed oils besides various alkaloids like elaeocarpidine, (+) elaeocarpiline (-) isoelaecarpiline, (\pm) elaeocarpine (\pm) isoelaecarpine), (+) isoelaecarpine etc.

Pulp of the fruit is sour in taste. In Nepal this pulp is used for preparing pickles and jelly. Since it contains citric acid, it has self preservative properties. The pulp is extremely effective against epilepsy.

Seeds are dark reddish brown in colour, round with uneven surface. It is normally divided into five distinct sections divided by a line in between. This type of seed is very common and is known as Pancha mukhi rudrakhsya. There are also seeds having more number of such sections maximum upto 14 sections which are rare hence costlier.

This seed not only worn as necklace by our saints but also

have medicinal value. It is believed that it prevents small pox if worn as necklace. In Rajasthan the paste that comes out by rubbing this seed against stone with water is applied externally in case of Small Pox. This paste acts as an expectorant if consumed. This paste if consumed with seeds of Tulsi (*Ocimum Sp.*) cures TB at initial stages. This paste is consumed with honey and Makaradwaja (an Ayurvedic preparation) to restore heart function and pulse beat in case of sudden collapse of heart functioning. Above all it is useful for diseases like reumatism, arthritis, and diseases of head and brain. It has the capacity to drive out stomach worms, can be an antidote for poison and help in improving appetite. It is traditionally used for preparing medicines for TB.

This plant grows wild on hilly tracts as mentioned above. Except in few places of Nepal where the fruit pulp is considered edible, its importance lies with its seed purely for religious reasons that to for ornamentation of our saints. But its real virtues are rarely exploited, hence its cultivation is rarely encouraged. We may think of cultivating this plant on commercial basis on our hills to commercially produce its self preserving pickles and jellies on the basis of know-how from Nepal. Its medicinal virtues are also not exploited properly, infact use of rudrakhsy as a medicine is a diminishing trend. Isolation of alkaloids and vitamin-C besides citric acid shall also justify its commercial cultivation provided such isolation or extraction is done commercially. On the whole this plant can assure us better environment, better health and better economy to otherwise neglected hilly tracts.

CHAPTER 97

HALDI

Haldi is known as Haridra in Sanskrit, Halud in Bengali, Haladi in Oriya and in various other names all perhaps derived from the original Sanskrit name Haridra. Its tuberous root is used for various purposes in our day to day life be as spices as preparation of food, as preservation of food or as edible medicine or as medicine for external application for enhancing our beauty. In our traditional texts there is mention about four types of Haridra are grown such as (a) Haridra (b) Amra gandhi haridra (c) Ban haridra (d) Karpur haridra. However according to modern botany there are a number of species in this genus. The most common of all that we use today bears the botanical name *curcuma longa* Linn., belonging to Zingiberaceae botanical family. This species we are going to discuss in this chapter in details. The second variety *Curcuma amada* Roxb., which is referred to as Amra gandhi haridra will also be discussed upto certain extent, to the extent of various compounds it contains.

The acetone extraction of rhizomes of amada species yield a colourless oil, curcumin and a phytosterol and an azulenogenic oil having pinene, camphor, 1 - β and 1 - α - curcumene and ar-turmerone.

The tuberous root of longa variety contains colouring matter such as curcumin, alkaloid such as Zingiberine besides antiseptic oil containing p-toylmenthy! alcohol, Ketonic and alcoholic constituents. It also contains essential oil, curcuminoids, Cholagog and Choleretic acid having anti bacterial properties.

It is infact the longa variety which is commonly used for various purposes. The leaves of haldi recently being used for manufacture of nicotine free cigarettes. It is also being used as cattle feed and as green manure. This leaf is also used in various

places for preparation of cakes and sweets. Many of our cakes are prepared by covering the raw cakes with haldi leaf before baking and the cakes are consumed after throwing away the leaves.

Almost all our curries are prepared by using haldi root paste or powder not only to give its desired colour, taste and flavour but because it is anti bacterial and anti oxidant hence serves as a preservative too. It is used both in vegetarian and non-vegetarian dishes alike.

Massaging children both during infancy and during growing age by haldi paste with mustard oil was common in Eastern, North Eastern and part of North India. That is because haldi has the capacity to prevent bacterial infection and ensures brightness of the skin. This also prevents eczema and skin irritations. That is precisely the reason haldi is also called "Barna bidhayani" meaning controller of complexion. By consuming one tea spoon full of raw haldi juice with honey we can ensure care of irritation during urination. About 15 to 20 drops of juice of raw haldi if taken with common salt during early morning before breakfast, complete removal of stomach worms can be ensured within few days. About 5 to 10 drops of juice of haldi taken with honey shall cure all liver diseases. About 2 to 3 gms of haldi powder fried in ghee if taken once or twice a day cures stammering. Haldi powder taken with Karela leaf cures measles. Raw haldi juice to the extent of one tea spoon full mixed with molasses and one tea spoon full of urine of cow cures filariasis. Haldi powder mixed with sugarcane molasses and mustard oil relieves asthma. Haldi ash with water applied on tumours is very effective. In case of sprain haldi with slaked lime if applied after heating is very effective. Raw haldi crushed into paste mixed with urine of cow, heated and if applied while still warm cures septic wound. Haldi water after washing used for washing eyes. Haldi if taken neutralises effect of tobacco smoking.

Haldi is basically a cultivated crop in India. It can be sold commercially since it has market demand in India Industries may also be planned based on haldi for producing haldi powder, medicines based on haldi and essential oil besides above for producing dyes, alkaloids, antiseptic oils and Ketones.

CHAPTER 98

DURBA

Durba is a small grass that grows wild in every nook and corner of our country but rarely cultivated. It grows upto a height of 2 to 3 cms. But it has importance in our religious rituals. It is a must for our blessing rituals. It is believed if one walks barefoot at dawn on the field full of durba, it ensures his good eye sight and balanced blood pressure. According to a legend, this grass was born from the hair of the body of Lord Vishnu one of the three most important Hindu Gods. It is known as Durba almost all Indian languages. In botanical nomenclature it is called *Cynodon dactylon* Linn., and belong to Gramineae botanical family.

The grass contains terpenoid constituents such as 28 triterpenes and its methyl ethers. It also contains fatty oil and a number of sterols.

Traditionally new born baby used to be bathed regularly in the water in which durba is kept dipped for a couple of hours. It is believed this water prevents ricket. There is no scientific explanation in this practice but there is need for further research. It is also believed that this grass has capacity to absorb more ultra violet ray. In this case also there is no scientific explanation but there is need for further research.

Durba is often explained as a fertile grass since it increases fertility of both animals and human alike. According to Ayurveda, if this grass after frying is consumed regularly with rice during lunch or dinner it not only increase fertility but ensures smooth delivery. It also helps in stabilising regular periods or restores delayed menopause. It is extremely effective in the treatment of leucorrhoea. To cure this disease juice of durba and juice of haldi if taken in equal proportion or if two tea

spoon full of juice of durba consumed with raw milk is perhaps one of the most effective treatment. The grass is also effective in the treatment of leprosy. The juice of durba with any hair oil if applied on head after heating and then cooling, it prevents fall of hair. The sceptic ulcer or wound or pimples can be dressed after applying the ghee in which this grass is fried. Any skin irritation due to fungi can be cured if paste made with durba and haldi is applied externally. In case of injury durba paste applied externally stops bleeding immediately. Dry durba grass powder is an excellent tooth powder and prevents piaeorrhea. Durba grass taken with Jamun leaves cures both ameobisis and dysentery. The juice of this grass consumed with sugar prevents vomiting. Durba powder taken as a snuff stops nasal bleeding. It is also a matter curiosity to now why durba stops bleeding.

With all its religious and medicinal importance this grass was never cultivated commercially since it does not spin money. We may think of cultivating it in fallow land unfit for any other crop so that industries may be planned for producing herbal tooth powder, medicines for stoppage of bleeding, medicines for fertility besides for extraction of various terpenoid and sterols needed as basic drugs.

CHAPTER 99

NIRGUNDI

Nirgundi is one of the many neglected evergreen tree that grows almost all over India. The tree is usually grown as pillars for fencing for agricultural land as well as home, particularly since no cattle relishes its leaves or rather it repels the cattles. It is known as Nirgundi in Sanskrit, Nishinde in Bengali, Sambhalu in Hindi, Begunia in Oriya, Aslaq in Arabic, and Fanzan Khist in Pharsi. In Ayurved it is often referred to as Sindubar. In botanical nomenclature it is called *Vitex negundo* Linn., belonging to Verbenaceae botanical family.

Various parts of this plant yield alkaloids like nishindine and various other unidentified alkaloids, essential oil, sterols besides terpenoid constituents.

The plant grows without much care and can easily be propagated by planting its branches. It can also be propagated through its seed. Its flower do have the nectars hence yield honey. Beekeeping industry may be planned based on this plant.

Almost all part of this plant is medicinal but its leaves and bark are frequently used. They are used for combating various diseases depending on types and combinations. By consuming two nirgundi leaves every day after frying in ghee increases memory or capacity of remembrance. The juice of the leaves boiled with til oil if applied externally cures boils, pimples and tumours. The juice of the leaves cooked with any hair oil by applying on head cures dandruff and prevents baldness. In case of joint pains, with or without fever, the water after boiling the leaves of nirgundi if taken regularly is the answer. But it should not be consumed by the persons having high blood pressure. The dry powder of the leaves if consumed regularly keeps the figure slim and trim. Half a gram of powder of the leaves if

consumed with warm water cures sciatica. Both leaves and bark acts as expectorant if consumed in proper dose. It cures white discharge and relieves leprosy. The leaves cooked in til oil and if this oil is used externally on the body cures skin irritations. The bark if consumed just like tea leaves, relieves asthma and by consuming regularly often cures this irritating disease. Root bark if consumed in appropriate proportion combats snake bite.

For preservation of woollen or costly clothings, the leaves of this tree can be used. Just by throwing in few leaves the clothings can be preserved while it does not leave any strains on the cloths. It can also be used for preserving pulses during storage. The smoke of dry leaves of this plant is excellent mosquito repellent. It is extremely effective for combating the disease connected with pregnancy, child birth and after. The leaves are effective against pharyngitis and tonsillitis, tooth and gum diseases if the water boiled with its leaves is gargled while still hot. The paste of the leaves after heating may be applied externally in case of tumours or any problems of swollen gland. The powder of the leaves cures bed sore if applied externally. The juice of the leaves is extremely effective in case of fever, rheumatism and arthritis. Oil cooked with nirgundi leaves can be excellent ear drop and cures many ear diseases. A few grain of dry leaf powder taken with water controls excessive urination due to old age or infants.

The plant is one of the neglected vegetable. It can be an excellent plant for plantation and its virtues as described above can be exploited commercially. Above all we can get essential oil, sterols, alkaloids and terpenoid which can be isolated and used as basic drug. It can give us a number of herbal medicines which can be packed and sold besides mosquito repellents. The plant can assure us a disease free society.

CHAPTER 100

UMBAR

Umbar is one of the wild grown plant found almost all over India. In Sanskrit text it is often referred to as Udumbar. The wood of this plant is extremely important in our rituals since vedic ages as this is one of the wood accepted to be burnt in yagnas and is must in case of certain yagna or rituals such as rituals connected with birth, death, marriages etc. It is also recognised as one of the pancha pallavs, recognised to be used for decorating the houses during festive occasions with religious flavour.

The plant is known as Umbar in Marathi, Gujrathi and in the parts of cow belt in and around Madhya Pradesh Udumbar in Sanskrit, Jagnadimbiri in Oriya, Gular in Hindi, Jagnadumur in Bengali. In botanical nomenclature it is called *Ficus racemosa* Linn., belonging to Moraceae botanical family. Its leaves are fairly large having very very rough surface. It grows maximum to a height of a metre or two. The flowers are usually not visible but remains inside the fruit, which we can only see if the fruit is cut into pieces. The fruit is usually slightly sweet and sour taste but normally found with full of insects inside it.

Various parts of this plant is medicinal. It contains Dichlorobenzoic acid, Dihydropsoralein, Hydroxycoumarin and various Enzymes. It is reported that there is a definite relationship of the post absorptive state to the hypoglycemic action of the bark. The latex of the bark yields a proteolytic enzyme. Bark also yields tannin.

The latex is used for various purposes. By external application it cures gland inflammation and relieves both inflammation and pain. It is also effective in case of piles.

Leaves and tender branches are used after converting into

semi-solid extract. The tender branch with leaves are beaten and boiled in water with low heat till it is thick, viscous semi solid mass. This is normally preserved and used as medicine in various proportion depending on type of disease.

In case of injury, this semi solid extract may be applied by which it stops bleeding, relieves from pain and ultimately cures. It is effective in case of dog or cat bite, bee or insect stinges if applied externally as it not only relieves from pain but also neutralises the poison. In case of injury without cut, this applied after diluting twice the amount of water externally which shall be of great relief. This extract diluted with four times water may be applied externally on boils or tumours. The extract may be diluted eight time water for use as gurgle in case of throat trouble, tooth and gum trouble or for any problem inside mouth. It is also very useful for haemoptysis and bleeding piles. Small galls on the surface of its leaves soaked in milk and consumed with honey is helpful in case of small pox. Dried Umbar leaves if taken with honey cures bilious affections.

The plant still grows wild. It may be cultivated or planted on commercial basis to give us many answers. At least the semi solid extract itself may be sold commercially with necessary preservatives. Latex may also be sold commercially. Above all enzyme, hydroxyconmerins etc. may be isolated and sold as basic drug. Propagation is also very easy and the plant does not need much care during its growth.

CHAPTER 101

BAMBOO

Bamboo is the proper name of the members of the Botanical family, which is a tribe of the family of grasses (gramineae). They are large, often tree - like with woody stem. The stems spring to form dense clumps. The largest of them reach a height of 40 metres. The stems are slender, 25 cm or 50 in diameter, and hollow. As in grasses generally, they have well marked joints or nodes, at which the activity is closed by strong diaphragm. They have numerous branches. In some the branches are spiny. The leaf blades are often short. They are usually jointed at the base, with a short stalk by which they are attached to a long sheath. The spikelets are usually many flowered, and variously arranged in racemes or panicles. The flowers differ from those of the majority of the grasses in having three lodicules and six stamens. Many of the species bloom annually, but some flower only at intervals of many years. Then the individuals of those species glow in bloom over large areas.

Bamboos are ordinarily rapid growing. In the rainy season, for a month they grow at the rate of 45 to 50 cms in a day. They are in about 30 genera and 550 species. They are characterised by woody pointed stems, commercially called culms, arising from their rhizomes which too are woody. The rhizomes are densely clustered. In a few cases they grow at intervals from a long creeping rhizome or in tufts. Many flatten at the nodes. Bamboos are generally round and smooth. They are hollow above the septas which are transverse at the nodes. However bamboos of some species are also solid.

Bamboos consists of fibre bundles. The manner of their scattering adds much to the hardness of the culms. The thickness of the outer shell and the deposit of Silica in the cortical layers make them hard. The culms have joints at intervals.

Of the 30 genera and 550 species, which inhabit the humid tropical regions, Asia and America account for 320 and 179 respectively. India has 136, Burma 39 and Japan and Philippines 30 each. Bomboos are distributed throughout the tropics. A few species extend into sub-tropics. Some have crept even into temperate zones as far as Great Britain and Japan.

Most of the species come across in our country are indigeneous. Of them there are two primary species *Dendrocalamus strictus* and *Bambusa arundinacea*. There are suitable for house construction. They are found in dry as well as damp regions. They are come across in other regions too, but along with other species. A few are ornamental.

In the forests bamboos grow naturally. Nowadays the paper mills have taken to cultivate them as plantations. They have become an important raw material for a number of wood based industries. Side by side with their conservation in the forests, production of bamboos is being stepped up by adopting modern methods.

Bamboos thrive best in monsoon forests. They attain their maximum development in them. They diminish into undershrubs in temperate regions. At high altitudes they look almost like grasses. They form rich belts of vegetations in the well drained parts of the monsoon regions. Quite dense bamboo forests are come across in West Bengal, North East Himalayas, Western ghats, Assam and North Eastern states besides Andamans and Nicobar island. They extend up to 3500 metres from Sea level in the Himalayas.

Owing largely to the difficulty in obtaining flowering specimens a systematic nomenclature is in a sad plight. As it is, sometimes it becomes impossible even to determine accurately the genus. Without flowers, the correct position can not be known. However four sub tribes are mentioned in "standard Encyclopedia of Horticulture, Vol I" as below.

1. *Arundinacea* : Stamens 3, palae of 2 keeled. So this sub tribe belongs to the genera (a) *Arundinaria* (b) *Phyllostachys*.
2. *Eubambueae* : Stamens 6 (c) *Bambusa* is the only genus under this sub tribe.

3. *Dendrocalameae* : Stamens 6 : palae 3 keeled (d) *Dendrocalamus* is the only genus under this subtribe.
4. *Melocanneae* : (e) *Melocanna* is the recognised genus under this sub tribe. It is an extratropical variety (a), (b), (c), and (d) above contain the most important species under cultivation.

Arundinaria may be separated from its sister *Phyllostachys* by its persistent sheaths and cylindrical stems. In the latter the sheaths are early deciduous and the internodes are flattened on one side. Generally *Arundinaria* and *Bambusa* can be separated by horticultural characteristics. *Dendrocalamus* is hardly separable except by its very big size. It is probable that many of the forms now classed as species of *Bambusa* will eventually go under *Arundinaria*.

Of the species mentioned above the most important from our commercial point of view are.

Bambusa arundinacea : Wild, a thorn bamboo popularly known as dowga, growing in West Bengal, Bangladesh, Orissa, Assam, Western Ghats and South India.

Bambusa Vulgaris : The golden bamboo Assam.

Bambusa tulda and balcooa . Bangladesh and West Bengal.

Arundinaria aristata : Eastern Himalayas.

Bambusa polymorpha : Bangladesh and Assam.

Pseudostachyum polymorphum : Valleys of Bangladesh, Assam and Sikkim.

Dendrocalamus strictus Nees : All deciduous forests throughout India.

Arundinaria Wightiana : Tamil Nadu around Nilgiri hills.

Bamboos are cultivated in at least six ways

- (1) By sowing seeds. This is what happens in nature. This can not be a popular method since bamboo do not flower every year.
- (2) By raising seedlings in a nursery and then planting them. This method is possible only when seeds become available. The usual practice is to plant one year old seedlings.
- (3) By planting rhizomes after separating them from one another.

- (4) By planting off sets. Culms one year old are selected for the purpose. Bamboo groves produce 30 to 40 shoots every year at the commencement of the season. A slant cut is made at a distance of 1 to 1½ metres from the crown and then planted.
- (5) By planting stems with at least one node.
- (6) By layering. This is said to be the most economical method. The usual practice is by dividing the culms and planting them or by planting the cuttings of stems before the annual growth has started.

Profuse natural regeneration or bamboos usually comes up after a gregarious flowering. It is in some cases so thick as to look like a green carpet of grass like seedlings after the first rains. Some of the seedlings develop into clumps after 6 to 12 years while others are left out in this struggle. After flowering the clumps dry up and die. If not exploited well in time they become inflammable and fires take a heavy toll.

Bamboo suffers from continuous grazing and fire. Procupines and pigs are its enemies. Elephants cause serious damage. There are also insects to attack the plantations. Bamboos are described as hungry plants. They repay well by proper treatment. They flourish in rich but not stiff loam. In the first one or two years, they should be well mulched to conserve the moisture. They should be sheltered from wind and watered during the growing period. There exists a belief that the regeneration of a plantation takes about fifteen years but actually under careful management 8 to 10 years become sufficient. Harvesting can commence after that period.

Culms reach maturity and become fit for cutting after 5 to 6 years of their shooting up. They are cut from the stalk a few feet above the ground. For the purposes of exploitations the area is divided into coupes and the latter are worked in rotation. Harvesting is not permitted during the rainy season.

Flowering is either periodic or annual. It is either gregarious, sporadic or both. Gregarious flowering is usually followed by the death of the clumps, but in some cases of sporadic flowering the clumps do not die after flowering. The gregarious flowering proceeds from one end of the forest to another by waves. In 2 to 3 years the entire forest flowers.

Annual flowering takes place in *Arundinaria Wightiana*, *Bambusa linesta* and *Ochlandra rheedi*. The cycle varies with species and locality. The cycle for *Dendrocalamus strictus* is about 40 years in U.P., 21 years in M.P and 28 years in other states. Flowering period of others species are given below :

<i>Ochlanara travancoricus</i>	7 years
<i>Arundinaria falcato</i>	28 to 30 years
<i>Arundinaria Supathiflora</i>	16 to 17 years
<i>Arundinaria Flaconeri</i>	30 years
<i>Arundinaria racemose</i>	30 years
<i>Dendrocalamus Strictus</i>	30 to 70 years
<i>Dendrocalamus hamiltons</i>	30 to 40 years
<i>Bambuseae</i>	32 to 39 years
<i>Melocanna bambusoide</i>	45 years
<i>Bambusa tulda</i>	30 to 60 years
<i>Bambusa Poiky norpha</i>	55 to 60 years
<i>Schizostachya</i> species	- 30 to 40 years

It is generally believed that after flowering of bamboo, drought normally follows. That is perhaps because rat population increases as the bamboo flowers supposed to increase fertility of the rats. It is also believed that honey out of bamboo flora is supposed to cure asthma. However all these beliefs are debatable

Bamboos 1 to 2 years old, cut in proper season are extremely soft and of an attractive colour. They are favourites of bamboo workers because they are easy to work on. They can do for the manufacture of articles needed for temporary use. They do not last even for few months. If the articles should last, they should be made from bamboos 4 to 6 years age. Older ones are hard to work. They are useless for the purpose of cottage industries.

Bamboo ought not to be cut during their period of growth i.e. from June to October. Those harvested during these months are usually attacked by insects and micro organisms. Those harvested during the dark half of the lunar month last. However there is no scientific basis on this belief.

The bamboos harvested in the forbidden months are attacked

by insects known as aspijitious, pancilium, fizopin and meneor. Each female gives birth to 50 to 60 insects which begin to lay eggs within 60 days of their birth. The culm is then ruined being eaten by them.

Bamboos suffer from fungal attacks. They are also prone to attacks from insects. Considerable damage is caused by some kind of beetles. Then bamboos become useless. However certain species resist the attacks to some extent. Mature bamboos too resist upto certain extent. Immature culms are easily attacked. The remedy adopted by laymen is to cut them after they become 5 to 6 years old, and left standing with the leaves in a vertical position for a week or so to drain away the water. They should be cut only during certain months which differ from region to region. Rainy months should be avoided.

The presence of sugar and other carbohydrates in the culms are said to be responsible for the damage. The quantity of the carbohydrates decides on how soon the attack begins. A very small quantity resists the attack. The remedy lies in destroying or eliminating them. The practice followed by our villagers from times immemorial is to keep the bamboos immersed in water for 3 months or so and then dry them. The water dissolves away all soluble matters including carbohydrates and removes them. Some administer smoke. The methods are simple. The bamboos are stocked on lofts above the hearth. Smoked bamboos are used for manufacturing high class bamboo wares meant for export. Depending on their end use, the bamboos are also treated by chemicals successfully various chemical combinations used are creosote and fuel oil, creosote and rape oil, copper - chrome - arsenic composition, copper-chrome-acetic acid, Zinc Chloride, Copper Sulphate, Zinc Sulphate, Carbolic acid, acetic acid, alum, Sodium fluoride, Corrosive Sublimates, Potassium-di-Chromate etc., following various methods of treatment.

Bamboo is one of the most important raw material for manufacture of paper. Bulk of paper manufactured in India are from bamboo. However before pulping bamboo has to be digested. But no attempt so far made to utilise the digested liquor which contains lignins, silicates etc.

Bamboo is called poor mans timber. Most of the houses constructed in rural India are constructed with the help of

bamboo only. In Assam even urban houses are made with the help of bamboo mats with lime plaster. This type of buildings are called Assam type buildings. Even otherwise frame work of the roofs may be of bamboos with a thatch of strand or leaves. Bamboos are extensively used for scaffolding, and for making ladders, bridges, aquiduels and for all kind of boats and rafts.

Yokes and axles of carts, tool handles, cordages, beds, sticks, lathes, tent poles, brushes, pipes, fans, umbrellas, toys, kites, musical instruments, spears, lance shafts, bows, arrows, torches and caps are other uses. The chief raw materials for baskets, wicker work, tiffin boxes, furnitures, chicks, mats and reinforced work are bamboo splits. Umbrella handles are made from selected strips by bending them over heated iron rods of the desired shape. Bamboo lacquer wares are beautiful and hence famous. In India North Eastern India is famous for bamboo wares notably various decorative items of Tripura, utility items of Nagaland, Manipur and Arunachal Pradesh like beer mug, japas etc., and decorative as well as utility items of Mizoram like the famous Mizo hat. Bamboo seeds are eaten by the poorer class both in India and China particularly during famine. They resemble those of rice, but somewhat bigger in size. Tender shoots soaked in water and boiled are made into curries and pickles. However, eaten raw they are poisonous. Sometimes flowering culms in dry localities exude a sweet brittle gum which is edible. In some cases, the hollow part at the joints contain water which is a saccharic matter. Sometimes rice is prepared inside tender hollow bamboo which is extremely tasty. This practice is prevalent in Bangladesh and North Eastern India. In Manipur this rice is called "Utangchak" which is offered to guests during festive occasions. Bamboo leaves are fodder. Cattle and horses relish them.

Bamboos are extensively used for defence purposes for hedges, landscape gardening and wind breaks. Oriental wicker ware in bamboo is unequalled for beauty and neatness of workmanship.

Next to Buddhism bamboo is the most valuable gift that India made to Japan. Now Japan grows more than a hundred varieties of bamboos. From bamboo alone, the Japanese manufacture 1400 articles in their home factories which number more than

14000. Bamboo chairs, bamboo radio sets are unique in artistic beauty. Bamboo for export finds expression in endless varieties of excellent Japanese handicraft - baskets, knives, forks, spoons, smoking sets, seviette, rings, buckles, buttons, door handles, hand bags, files, ply wood, walking canes, fishing rods, knitting needles, toys, shoes, compacts, trays and pipes which are among the myriad products made out the versatile wood. A potted bamboo is a gem. It also plays an important role in Japanese architecture, for, it is often used as an imposing pillar before the alcove, the sacred place in a Japanese house.

All the above aspects are known to us upto certain extent but we are not practising precisely because of pressure from paper lobby. As days passes by bamboo groves are vanishing quickly to add profit to the paper mill owner at the expense of environment and at the expense of our pockets. We not get any bamboo in future it will not affect the mill owners since they can switch over to other raw materials, but it shall affect badly to our rural artisans depending on bamboo economy it will ruin our villagers who build their cheap houses with the help of bamboo above all we shall loose an important medicinal herb.

Yes, bamboo is also an important medicinal herb which we often forget. It yields acids such as oxalic acid and benzoic acid, sterols such as β - sitosterol and stigmasterol, terpenoid such as luped, α - amyrin, β - amyrin, trielin, tavaxerol, β - amyrin methyl ether and ferneol and above all polysaccharides. Other constituents are 2 - furaldehyde, lignin hemicellulose, holocellulose, miliacin, glutinone, glutinol, Cylindrin, Crusgallin, Cholin, betain, and cynogenetic glucoside. With combination of so many organics the bamboo plant bound to be medicinal

At the time of delivery of calf if the cow is fed with bamboo leaves, the plascenta fall almost immediately. The leaves also cures diahoerrhea of cow and oxens. The juice of bamboo leaves if taken with honey cures cough. The paste of the thorn of *Bambusa Spinosa* is applied externally on boils and tumours. Pain of pile get reduced if the bamboo leaves are boiled, filtered and if this filterate is used for taking bath after oil massage. Tender bamboo leaves heated and applied externally relieves gout. Bamboo roots are extremely effective for curing Oedema

and strangury. This root paste with cows milk if taken cures poison due to dogs bite. Ash of the root mixed with til oil is applied on bald head while this ash is a good tooth powder. the smoke of green skin relieves asthma.

Rarely one few bamboos (perhaps in one or two bamboos out of one hundred or two hundred) after matured a whitish brittle portion is noticed which is highly medicinal. It is called "Bangsa Lochan" in India While "Tabashir" in Yunani medicinal scriptures. Indian legend describes that this is born due to fall of water from Swati star. However Bangsa Lochan now being used for preparing Ayurvedic medicines are usually imported from Indonesia. This is one of the important ingredient of Chawvanprash. Yunani hakims describes this as aphrodisiac and tonic. Chemical report says it contains 50 per cent Silica besides minerals like potash, iron, Aluminium and moisture. It is extremely effective in TB, Cough and is a good expectorant.

Therefore, due to mismanagement of bamboo forests by the paper mills controlled by our monopoly houses, it is not only destroying our environment but snatching away the income of crores of our village artisans but destroying answers to many of our health problems. Shall we remain silent?

CHAPTER 102

BASOK

Basok is described in our epic texts as Brisha or Athrushak and often referred to as highly medicinal plant. It is said that it acts on most important parts of the body like thigh, heart and stomach region, throat and head region. It is supposed to purify blood improves liver functioning and is a good expectorant even for chronic cough. It is called Adusha in Hindi, Basok or Basa in Bengali. In botanical nomenclature it is called *Adhatoda vasica* Nees, and belong to Acanthaceae botanical family. This evergreen plant grows wild all over India often as garden plant. It grows upto 2 metres. It flowers during the month of July and August. The white flowers appears in bunches enhances beauty of the natural surrounding.

Seeds of the plant yield 25.6 per cent fatty oil consisting of arachidic, behenic, lignocric, oleic and linoleic fatty acids besides Sitosterol. This oil can be excellent raw material for soap besides being medicinal due to presence of sterol. It can be useful for various other purposes if the fatty acids, glycerol and sterol can be isolated commercially. Oil cake can be used as manure, cattle feed and for manufacture of industrial adhesives.

The plant yields vasicine, 1-peganine and small amount of essential oil. Oil from leaves, flowers and roots active against Tubercle bacilli. An alkaloid vasicinone having a weaker bronchodilator action than adrenaline can be isolated.

On destructive distillation the plant yields a liquid containing two bases with antispasmodic properties, and the steam distilled principle from the leaves possess anthelmintic and weedicide properties.

It may be mentioned that this one of the drug which often consumed raw like neem. It is effective if applied in case of

various diseases. In case of chronic hyper acidity if allowed to remain may cause many serious diseases like cancer, blood pressure and heart diseases. About 7 to 8 gms of basok bark boiled in 4 cups of water till one cup of liquid residue remains. This concentrated liquid after filtration if consumed once or twice a day cures this disease. This liquid has capacity to kill all stomach worms. A concentrated liquid of bark and leave of basok prepared same way as above with Sugar cane candy or sugar if consumed stops internal and external bleeding relieves breathing troubles due to asthma, cures eczema and purifies blood. Dry leaves of basok if smoked in pipe relieves breathing trouble due to asthma. Basok leave may be applied externally to get rid of bad odour on the body since it is a good deodorant. The juice of basok leave with ash of conch shell if applied on the body externally assures better complexion. Paste of basok leave in the urine of cow if applied externally cures ring worm. Paste of basok leaves, placed in a clean cloth if given hot foment relieves pain due to piles. In case small pox epidemic spreads the water boiled with basok leaves if consumed regularly may be a good prevention. Basok leaves if kept in drinking water kills all the germs. That is perhaps the reason why we had the tradition of throwing basok leaves in village tanks and ponds. To detect whether there is pregnancy of tumour basok leaves used to be used traditionally.

Basok still grows as a wild or garden plant. It is not being cultivated commercially. That is precisely the reason why collection of basok seeds for extraction of oil is difficult. That is also the reason why we are not in a position to manufacture so many useful medicines based on basok commercially. That is also the reason why useful basic drugs could not be isolated commercially. Let us think on this plant. Let us propagate it to assure a brave new world.

CHAPTER 103

SINGHASYA

Singhasya, often referred to as Singhapuchya or Rambasok is basically a plant found in the sub Himalayan tract from Garhwal of Uttar Pradesh to Bhutan besides Assam, Khai hills of Meghalaya and foot hills of Nagaland, Mizoram, Arunachal Pradesh and Tripura. It is also called Tamra puspa basok. The term basok is frequently referred because the plant is similar to basok as described before the belong to same botanical family. Only physical difference noticed being the colour of its flora is yellowish red instead of white as in case of basok. In botanical nomenclature it is called *Phlogacanthus thysiflorus* Nees., belonging to Acanthaceae botanical family. This plant however is not frequently used as medicinal plant as in case of basok perhaps because of its limited availability.

The seed of this plant also yields a fatty oil which can be used as raw material for soap, isolation of fatty acids and glycerol. The cake can be used as manure, cattle feed and for manufacture of adhesives.

During its flowering seasons, beekeeping industry may be planned as this flora also yields honey with appropriate L/D ratio.

Various part of this plant yields β - sitosterol, Lupeol, Betulin, one diterpene lactone and a number of other terpene type compounds. They could be isolated at laboratory scale but by isolating at commercial scale the plant could have become source of a number of basic drugs and chemicals.

The plant can be used for combating various diseases. The syrup made from its bark and leaves cures whooping cough. Female Ovary secretes two hormones such as Estrogen and Progesterone. Disproportionate release of these hormone lead to

a disease called Menorrhoeia causing excessive bleeding during periods. The herbal preparations made from this plant assures cure of above disease by bringing back the balance between the ratio of secretion of two hormones. The plant is useful for TB, various types of coughs and can be considered as an expectorant.

The leaves yield an essential oil which can be extracted by steam distillation and can be used for various purposes.

The plant is a neglected plant even by our traditional Ayurveds except for some local use. More research need to be made from extracts of this plant.

CHAPTER 104

SIRISH

Sirish, often referred in our traditional texts as Uddanok is a popular plant in India not only for its medicinal value but also for its gum which is directly used as a natural adhesive for various purposes. This adhesive was extremely popular before industrial adhesives came to market and even today synthetic adhesives are often sold as Sirish gum due to its popularity. Even the sand paper used for various purposes are commonly called "Sirish Kagaz" with the understanding that the grains of sand are stuck to paper surface with the help of Sirish gum only.

In botanical nomenclature this plant is called *Albizzia lebback* Benth and belong to Leguminosae botanical family. However, there are several other plants in the same genus and family are also called Sirish like Krishna Sirish etc., are also discussed briefly here though principal discussions shall be on lebback variety. Other Sirish varieties are *Albizzia amara* Bolvin, *Albizzia procera* Roxb., and *Albizzia odoratissima* Benth. These plants are found wild or grown as garden or avenue plant almost all over India.

Lebback variety yields essential oil and amino acids such as cystine, aspartic acid, threonine, serine, glutamic acid, proline, glycine, alanine, valine, methionine isoleucine, leucine, tyrocine, phenylalanine, lysine, histidine, arginine, tryptophan etc. Flowers of this plant yields saponins and sapogenins. The saponin mixtures from the seeds yield oleanolic acid and echinocystic acid. Gum also yield a number of amino acids and saponins. Seeds of amara variety also yield a sapogenin, echinocystic acid. Seeds of procera variety yields saponin and sapogenins.

Seeds of *odoratissima* variety yield a new saponin

odoratissimin. By hydrolysing the saponins from seeds yields two triterpenic acids and machacronic acid. The plant yields a dark brown insoluble gum in the form of tears.

The flowers of all the above varieties do have nectars. Therefore beekeeping industry can be planned during its flowering seasons. Sirish honey is acceptable due to its proper L/D ratio having higher Luvlose content.

As medicinal plant it is not only recognised in India but round the world although the plant is casically of oriental origin. Since it has the capacity to cure many of the hereditary diseases, This plant can be utilised to attack various cells by Gene-Genetic methods, perhaps may rectify the defects of a person.

The bark of the plant is extremely effective in case of rat bite as it is the antidote for rat poison. Root bark is effective for all type of insect bite or stings. For half headache, immediate relief is assured if root bark powder or seed powder is used like snuff. Root bark powder if used as tooth powder assures healthy gum and strong teeth. Fruit paste with ghee if applied externally removes black spots on the body.

Excessive perspiration causes weakness. In case of fatty persons, excessive perspiration is natural since this excess sweat is due to the fat. But often it is found excessive perspiration occurs in case of slim persons particularly sweating a palms or foot. This indicates that the person belong to a family with history of asthma or eczema and this type of perspiration is one of the expression of above diseases. Excessive sweating causes weakness because it carries out a lot of minerals needed for our body. In such problems the root bark of Sirish with appropriate doses act miraculously. The dose depends of age of the person, intensity of the disease and other conditions. Similarly in case of some persons, excessive sweating while in sleep often noticed. In this case also root or root bark of Sirish acts instantly ultimately bringing back the vigour. The juice of the leaves of the Sirish if taken cures night blindness. The paste of the seed may be applied on eyes in case of any irritations. Seeds are effective in case of goitre. Sirish flower may be consumed in case of any problem of Semen or ejaculation. Yunani hakims often use Sirish wood as medicine. They cook the wood in water till the water is thicker, filtered, and this filtrate is usually prescribed as

medicine for any blood diseases, for dermatitis or skin diseases and for asthma. Seed powder taken with Sugar cane candy and hot milk helps in concentrating semen. The gum taken with water increases sex vigour.

Traditionally, as mentioned before gum was used as adhesive. It may still be used if the plant is cultivated commercially and the gum be extracted accordingly. This gum apart from being a good adhesive, is also a effective coagulating agent. Being edible it can be safely be used in food and pharmaceutical industry as industrial coagulant. This gum also can be used in soap to coagulate the dirt in water and as a good foaming agent.

The plant as master piece creation of nature must be

CHAPTER 105

KADAMBA

Kadamba has important place in Baisnav cult amongst Hindus not directly but indirectly. Radha and Krishna, the cult God and Goddess used to have their romance below a Kadamba tree, hence while worshipping Radha and Krishna, the Kadamba tree is also worshipped automatically. It is called Kadamba or Kadam or in similar other names all over India. There are various species under same genus and family. In India various species are called Girikamba or Bhu Kadamba and/so on. In botanical nomenclature Kadamba is called *Anthocephalus indicus* A. Rich belonging to Rubiaceae botanical family. Other species available in India known as Kadamba are *Adina Cordifolia* and *Anthocephalus Cadamba* Miq. belonging to same family. However we shall discuss mainly about indicus variety here.

Various parts of Kadamba tree yields tannins besides acids such as quinonic acid and Cinochotannic acid. Bark contains alkaloids, steroids, fats and reducing sugars. Flower yields essential oils which is extracted traditionally by hot boiling water but with further improvement we get more yield if steam distilled.

Kadamba flower appears during end of rainy season and in autumn season. Since the flower has nectar beekeeping industry can be planned during the flowering season. Consumption of flowers and pollen of Kadamba is supposed to prevent diseases caused due to change seasons and gives us enough of vitamins and minerals to give strength. The humming bees when collects honey from Kadamba flowers, enriches the honey with more of vitamins and minerals from its pollens. Kadamba also have sedative action which further helps in romance. Nevertheless, if

beekeeping industry be planned based on Kadamba we will get healthier honey rich in vitamins and minerals with proper L/D ratio.

Kadamba belong to same botanical family as Cinchona. Hence its bark contains same organics and drugs as Cinchona. Therefore Kadamba can be effectively applied in case of malaria since it contains quinine as quinonic acid. The bark if consumed at appropriate proportion cures giardia completely and removes intestinal flagellats. However tender bark is more effective than matured bark.

Since ancient days Kadamba leaves were effectively used to cure pimples and used for fomenting or applying externally to relief pain due to arthritis, or rheumatism. The bark past may be applied externally in case of hydrocele on which leaves may be used for dressing. The juice of the leaves are extremely effective if consumed at appropriate doses to remove intestinal works such as round worm and thread worm from the intestine. Since it acts as a vermifuge it has less harmful effect on the child. Tender bark if applied on tumour after heating not only relieves pain but slowly cures it. For bad mouth odour, irritation inside the mouth, stomatitis etc., the water boiled with Kadamba flower or leaves if gurgled yields good result. Bark of the tree relieves from high temperature and acts as tonic for quick recovery. It controls intensity of vomiting if administered appropriately. The concentrated syrup made out of its bark and leaves if taken at appropriate proportion with milk and ghee cures many urinary diseases.

Kadamba, due its sedative action, was used as drug since epic days. Traditionally few grains of Chana (*Cicer arietinum* Linn) if left over night in the hole of in a stem of this tree, can be used as sedative drug next day. However the Kadamba as a drug is less harmful and does not have any permanent effect on health.

Kadamba timber is used for less durable items. Most of our packing boxes are made out of Kadamba timber. It is also used for cheaper furnitures, such as small chairs for temporary use. It is also used for house construction and can be used as a raw material for paper manufacture. Above all it can also be a good fuel wood.

Kadamba inspite of all its virtues yet to be cultivated commercially. Still it is the victim of both afforestation and deforestation. In one hand it is worshipped being a part of Krishna cult while on the other hand it is felled. It need to be worshipped by propagating it to give us better environment better aroma and better health.

CHAPTER 106

RAKTA CHANDAN

Traditionally the semi solid paste of chandan wood is considered sacred in India used in various rituals. It is considered coolant and also used as medicines. According to one ancient texts four types of Chandan are, described such as Swet Chandan, Rakta Chandan, Kaliyuk or Peeta Chandan and Kuchandan. During modern time we could identify only three types of chandan such as Rakta Chandan (*Pterocarpus santalinus* Linn.), Swet Chandan (*Santalum album* Linn) and Kuchandan (*Adenthera pavonina* Linn). Swet Chandan is normally known as Chandan bearing botanical name *Santalum album* Linn belonging to Santalaceae botanical family which is discussed in details in a separate chapter. Other two Chandans referred above belong to Leguminosae botanical family. In botanical nomenclature Rakta Chandan is called *Pterocarpus Santalinus* Linn.

The term “Rakta” refers to blood. The term Rakta Chandan therefore is derived due to two reasons, first being this tree is extremely useful for curing diseases connected with blood secondly perhaps because its wood and the paste of the wood is almost blood red in colour. This tree grows upto 8 to 10 metres and are found mostly in South India notably Karnataka and Tamilnadu around Nilgiri hills. Various parts of this plant contains glycosides, essential oils, colouring matters and marsupium.

Although inferior to Swet Chandan this Chandan also yields essential oil which can be extracted by steam distillation which can be used as flavour, perfume and for various other purposes adding aroma. The aroma is identical to that of Swet Chandan but is cheaper.

The seeds of this plant also yield fatty oil that can be used for manufacture of soap and cosmetics. Flowers do have nectar hence yields honey. Therefore beekeeping industry can be planned during flowering seasons. Leaves can be good fodder and used for green manuring.

So long the blood circulates in our body through our veins normally we are keeping well. But in case of any defect or injury this valuable liquid tend to come out. If there is no injury it comes out through various body out lets like eye, ear, nose, hair, roots, rectum, penis or vagina etc. Often bleeding comes out by cracking open our skin. The root cause of this mishap is due to heat generated inside our body due to various diseases and weakness. The best solution to combat this problem is obviously Rakta Chandan.

In case of extremely high temperature of our body due to fever the dust of Rakta Chandan wood soaked in hot water for 3 to 4 hours and then if this water is consumed controls the temperature. (10 to 12 gms of powder to be soaked in 250 ml of hot water). If the dust is not available a piece of may be rubbed to form paste which may be converted into slurry made similarly as above if consumed cures urinary troubles such as painful urination or urination with bleeding. In case of blood vomiting due to liver trouble to above slurry acts almost instantly. The slurry also ensures regular menses for women. Water taken with Rakta Chandan also stops bleeding through nose and ear. In case of mumps, Rakta Chandan paste produced by rubbing the moist wood against stone may be applied externally to get relief. The paste is applied externally in case of ring worm and various skin disease caused due to bad blood. The water boiled with Rakta Chandan wood if gargled stops bleeding of gums and teeth. Paste is applied externally in case of headache, bad boils, septic ulcers, pimples and wounds. If applied all over the body during acute summer it gives soothing effect and prevents heat stroke.

Rakta Chandan wood is a good timber. But it is not used for making furnitures etc., due to exorbitant price. It is however used for manufacture of small decorative items by carving. Crafty artisans produces many beautiful items. The tree is of commercial importance hence grows in plenty.

CHAPTER 107

SONKI

This evergreen plant is commonly found in coastal area from Bombay to Bengal besides Srilanka to Singapore. It is called by various names but called Sonki in West Bengal, Bangladesh and Orissa. In botanical nomenclature it is called *Wedelia biflora* D.C. and belong to *compositae* botanical family.

In Thailand the plant is effectively used for headache and fever. Roots are recommended for vaginal discharges, gonorrhoea and gravel.

Pounded leaves are used as a poultice for discoloured skin, cuts insect-bites, ulcers, sores, swellings and varicose veins. It is also applied to the abdomen of women after child birth and for undefined pains. Juice of the leave is given as a tonic in cows milk after childbirth; also in a mixture with rhubarb for chronic constipation. Boiling leaves given for haematuria diuretic action. Goats if they browse on old leaves and stems are poisoned, vomit and die.

Flowers are violently purgative. It can only be used as part of any medicinal preparation in a small proportion. It contains nectar. Hence beekeeping industry can be planned based on this flora. The plant grows wild in the areas that it grows but rarely cultivated commercially not in its virtues are utilised appropriately. It is necessary to plant for its scientific growth for our sustainable development.

CHAPTER 108

JAL - JAMANI

Jal-gamani is one of the most common creeper in India, Far Eastern Countries, China, Japan and part of Africa which usually grows wild in warm humid and tropical climates. It is called Chhilihint in Bengal and Bangladesh, Dadayia in Medinipore district of West Bengal and down below upto Cuttack and Puri districts of Orissa. In Hindi belt it is called Jal-gamini, Basan bael, Chhureta, Farid buti and Patala garudi. In botanical nomenclature it is called *cocculus hirsutus* Linn., belonging to Menispermaceae botanical family. It can be identified very easily. If few leaves are taken and rubbed inside water by hands, the water shall become gel like card. It is basically considered as a good rejuvenative.

The plant yields alkaloids such as coclaurine, trilobine, isotrilobine, menisarine and tetraadrine, quaternary base such as Cocsarnine and 10-ethoxy - 1, 2, 9 - tri-methyl-vaprophin besides alkaloid glycosides and sterols. Roots show the presence of D - trilobene and DL-Coclaurine. Water soluble fraction of the extract is sedative, hypotensive, bradycardiac, cardiotonic and spasmolytic.

It is basically considered as a medicinal herb. The leaves have extremely good influence on urinary system. About 3 to 4 grams of its leaves crushed in water if taken as syrup with sugar, twice daily relieves irritation during urination, cures spermatorrhoea and venereal diseases. Alternately dust of dry powder of leaves may be preserved and if 6 to 8 grains of this dust is taken with water or milk not only have above effect but also cures constipation by assuring proper bowel movement. Above preparation with camphor prevents semen secretion during sleep and increases concentration of semen. Root purifies blood and relieves arthritis and rheumatism. For dry eczema, the gel

created in water with its leaves may be applied externally. It is also good for skin diseases and itching if applied externally. The paste of the root with ghee or butter if applied on tongue cures irritations or injury. Paste of the leaves if applied externally relieves burning injury, tumours or sceptic injury etc. It immediately relieves from pain and irritations creating a soothing effect.

It still grows wild but not being cultivated since it is considered non-commercial. Hence as natural change due to deforestation and urbanisation its eradication has become normal. It should not only be stopped immediately but its propagation should be encouraged.

CHAPTER 109

MADAYANTIKA

Madayantika is extremely popular herb in India used mostly as cosmetics. Its colouring matter present in leaves is used for decorating palms nails etc. of hand especially for brides. It is also used for colouring hair and as a coolant. It is popularly known as Mehendi but also called by various other names such as Mendh, Mendhuka, Medi and so on. In English it is known as Henna. In botanical nomenclature it is called *Lawsonia inermis* Linn. or *Lawsonia alba* Lam, belonging to Lythraceae botanical family.

Various parts of this plant yields glycoside, essential oil, colouring matters such as 2 - hydroxyalphanaphthoquinone besides above other constraints are hennotannic acid and fatty alcohols. Mehendi seeds yield 5.6 per cent non drying fatty oil. Leaves yield a colouring matter lawsone. Yield of essential oil is 0.02 per cent containing β - ionone.

Oil from Mehdi seeds in non-drying in nature and can be an excellent raw material for manufacture of soaps and cosmetics. However, considering the yield solvent extraction is preferable. Oil cake can be used as manure, cattle feed and an excellent raw material for manufacture of industrial adhesives.

Essential oil from flower may be extracted by steam distillation. It is used as perfume and is very popular. Traditionally it used to be extracted with boiling water for production of attars. It can be used in soap and perfumery industry. Flower also have nectar. Hence beekeeping industry can be planned, and this honey is supposed to be very healthy with proper L/D ratio and sufficient minerals and vitamins from pollens. Flower is also used as dye. The above perfume is used in incense sticks or agarvattis during our rituals or otherwise. The aroma has a sedative effect.

This plant considered to be highly medicinal. The root of this plant preferably tender root is made paste with wash water of half pounded raw rice if taken twice daily with the above wash water cures hepatitis. It will be still better of sugar candy juice or coconut. One spoon full of juice of the leaves taken twice daily with water of milk and sugar stabilises semen secretion, cures Leucorrhoea and ensures proper bowel movement. About 25 gms of the leaves boiled in water and filtered and if this filtrate is injected through vagina as douche cures leucorrhoea and relieves itching. Traditionally quantity of haemoglobin in blood used to be tested with the help of juice of mehendi. Method is very simple. The juice of Mehendi leaves is applied on the palm. If after some time the place where it is smeared becomes reddish, it indicates haemoglobin is appropriate. Otherwise there is less haemoglobin hence the person needs treatment. The juice of the leaves applied on nails or hair not only because it adds to the beauty and gives aroma but it ensures healthy hair and eye sight. The juice of leaves mixed with mustard oil if massaged relieves body ache. Water after boiling with haritaki and mehendi leaves if applied on head prevents falling of hair. In case of displacement of the uterus the leaves are useful. Mehendi leaf with nisinda leaf cooked with til oil if applied externally relieves sinus. Pillow filled with mehendi flower if use ensures sound sleep. Water boiled with mehendi leaves if gurgled relieves both throat and mouth diseases. Juice of mehendi leaves is a good ear drop. Juice of the leaves with any massage oil if applied on the body removes the wrinkles. Leaves are applied externally in case of small pox and chicken pox. It is extremely effective in case of dandruff and good for tooth and gum diseases.

The plant is cultivated mostly as garden plant. It is occasionally cultivated commercially for its colouring matters and essential oil. But we must also think about utilising its other virtues so that people shall be encouraged for its propagation.

CHAPTER 110

ANTAMUL

Antamul should not be confused with the popular herb Anantamul to be discussed separately. Antamul is basically a weed found almost all over India, hence is a victim of weedicides. The term antamul has been derived from "Antra" meaning intestine since it has the capacity to cure intestinal diseases. This weed belongs to Asclepiadaceae botanical family. There are over 50 species of this plant around the world. Most commonly found species in India is *Tylophora indica* (Burm f.) Merr. It is often referred to as Indian Ipocacunaha since it acts like Ipocac in case of amoebic dysentery.

The plant yields essential oils, sterol, alkaloids notably tylophorine and tylophorimine besides other basic constituents.

In South India, particularly on coromandal coast, the root of this plant was used for the treatment of blood dysentery. However, excessive consumption of this root may cause complete stoppage of stool and urine hence may become fatal.

In Bihar it is used as a veterinary medicine. In case of asthma or breathing trouble of cows the creeper is used as garland.

In Konkan region juice of the leaves is used for vomiting. The dry powder of the plant is used for curing blood dysentery in Konkan.

For asthma particularly for bronchial asthma the leaves are chewed in empty stomach early in the morning. However no food to be taken within half an hour of taking this leaf. Alternately dry powder of the leaves may be taken at appropriate dose twice daily which relieves bronchial asthma.

The plant as a weed being destroyed with the help of weedicides as the modern agriculture sets in. There is still time to preserve it as a herb due to its above virtues.

CHAPTER 111

IMLEE

There are very few carry prepared by South Indians without adding Imlee. Imlee water is a must in their menu. This large tree however grows all over India and other Assian countries. It is called Jamddutika in Sanskrit, Tentuli in Oriya, Imlee in Hindi and cow belt, Amlīka also in Sanskrit. There are a number of plant in this genus but most common being the variety having red pulp and pink juice commonly known as Lal imlee. It is called *Tamarindus indica* Linn in botanical nomenclature belonging to Leguminosae botanical family while in English it is called Tamarind.

Imlee Kernel yields polysaccharides while its leaves yield glycosides. Entire plant yields tartaric acid, malic acid, polysaccharides and oxalic acid.

Imlee seeds consists of a cream coloured Kernel surrounded by a dark reddish brown husk. Solvent extraction of this Kernel powder with ethyl or petroleum ether yields 6 to 8 per cent oil. This oil may be used as edible oil and excellent for manufacture of soap and cosmetic industry. But since the tree grows wild and scattered collection of this seed is difficult and quality control of the seed is practically impossible. This discourages commercial exploitation of this oil.

In many places in India the crushed seed powder is used as crums for preparing cutlets. Sprouted seed if consumed controls blood sugar and urine sugar. The seed crushed and boiled and then if this water is taken controls diabetes. The seed husk yields tannin which can be used for tanning hides. The seed when boiled till the water is thick, gives reddish fluid which is used as dye for decorating clay images. The husk of the seed is used for fomenting piles, relieves the pain. Above all this seed has

capacity to increase sexual desire and increases the capacity of sexual act. In a way it brings back the youth. Dehusked seed was used for preparation of sweet dishes.

Imlee leaves are used for preparation of food items. In Orissa imlee leaves crushed into paste with chilli and salt and then fried are consumed with watered rice. It is also used as vegetable for preparation of curries for lunch and dinner. The leaves contain sufficient amount of amino acids hence extremely good for health if consumed regularly. Water boiled with imlee leaves if consumed relieves piles and irritation during urination. Water boiled with imlee leaves if cooked with oil and cumin cures dysentery even chronic cases leaves boiled in palm toddy if applied externally relieves pain due to arthritis and rheumatism. It is also used for fomenting sprains and the water is used for gurgling.

The pulp of the fruit not only tasty but also healthy. It is believed that, it has the capacity to dissolve cholesterol and therefore prevents arteriosclerosis. Those who take imlee regularly usually remain slim and trim and usually have smoother skin. It is said if imlee is taken regularly even winter skin irritation does not take place. Imlee is extremely effective to neutralise alcohol and Suddhi hand overs. Water soaked imlee pulp relieves kidney trouble, even neutralises swellings of leg and hand, if consumed. Roasted imlee prevents heat stroke. Fried imlee with betel if massaged relieves chest pain due to cold and cough. Imlee turmeric leaf is consumed by the persons affected by small pox. The ash of the husk of the fruit is considered as medicine in many diseases. The dead bark prevents vomiting.

Imlee is called Jaria dutika since no plant grows under its shadow (Jama is the Hindu pantheon of death and dutika is the messenger). In spite of all good qualities, if imlee is consumed regularly it reduces sex urge and reduces fertility.

Nevertheless, this useful plant in spite of appropriate commerce grows wild. We must go for scientific plantation to get appropriate quality of its products.

CHAPTER 112

CANES

Canes are a minor forest produce. They grow and can grow only in dense forests. They are slender stems rarely 50 mm thick but growing to lengths of 200 metres. They require supports of numerous tall trees in close proximity. They require plenty of water for their maintenance. Hence to grow them as a plantation except in forest is difficult.

The world's production of canes is very small. They have limited uses, which are confined to furniture and basketry where few materials can equal them. They do not figure in the world's trade.

The name of cane is usually applied to plants having long slender reed like stalks or stems. But what are known to botanists as cane is the *calamus*, a genus of the palmaceae family with over 300 species. They are distributed in the virgin forests of tropical and subtropical regions. Most of them are climbers with long slender stems rarely reaching a diameter of 4 cm. The stems are beset with numerous sharp hooked spines on the leaves or leaf sheaths, and flagellum like prolongations. With their aid, the stems scramble or climb pushing through the surrounding bushes and branches of the neighbouring trees in quest of light gripping them for support. The stems go on from tree to tree railing and twisting themselves round them often forming loops presenting the appearance of festoons.

The stems grow to lengths of 100 to 200 metres. They are usually cylindrical and of uniform thickness. They are straw yellow; and are covered all over with spiny leaves and leaf sheaths. They are solid, flexible elastic and strong. Their outer surface is hard and smooth possessing a varnished appearance. The distance between inter-nodes vary from 5 cm to 60 cm.

throughout their lengths the stem contain strong fibres. These stems are the canes or rattans of commerce.

A few of what are called canes belong to general like *Daemonotrops*, *Ceretolobes*, *Plectoconia* and *Karathalasias*. Many of these are shrubs. They are not of much importance.

Canes require for their growth a high and moist temperature throughout their period of growth. They are extremely greedy of water. These requirements are satisfied by the densely wooded ever-green tropical forests of the Malayan Archipelago, Sri Lanka, Burma and parts of India, namely the Himalayan and Sub-Himalayan regions, Assam, Manipur, Mizoram, Nagaland, Arunachal Pradesh and the Western Ghats.

Out of the 300 or so species about 30 are come across in India. Of them the following are of economic importance.

- (1) *Calamus acantha Spathus* (Griff) - Local name Gowri bet. Internodes are at distances of 15 cm and diametre 2 to 2.5 cm. Occurs in Nepal, Sikkim, Bhutan and Meghalaya.
- (2) *Calamus andamanicus Kurz.* - Internodes at a distance to 15 to 20 cm and diametre 2.5 to 3 cms. Occurs in Andamans.
- (3) *Calamus flagellum Linn.* - A robust cane. Local name Nagbetta or Nagagola bet. Occurs in Assam, Nagaland, Manipur, Mizoram, North and South Kanaras.
- (4) *Calamus garuba Buch.* - Local name Kanta bet. Internodes and at a distance of 25 cms. Occurs in Orissa, West Bengal and Assam.
- (5) *Calamus pseudo tenuis Becc* - Local name Kanbetta. A slender cane - extensively climbing. Occurs in Western Ghats. It grows 130 to 160 metres.
- (6) *Calamus rotung Linn.* - Local names : Chachi bet, Peramba, Pemu. It has slender but strong stems. Occurs in Madhya Pradesh and South India.
- (7) *Calamus tenuis Roxb.* - Local names : Bhandari bet, Jati bet etc. Stems are very long and resemble rotang, growing upto 165 metres. Occurs in Sub-Himalayan regions from Dehra Dun to North Eastern India.
- (8) *Calamus thecostoti Hook* - Local names - Valia, chural Jeddu beta etc. Diameter upto 4 cm. Occurs in Western Ghats.

- (9) *Calamus viminalis* Wills - Local names : Bara bet, Perambu, pemu etc. Occurs in West Bengal and Tamil Nadu.

Definite information about when canes become mature for harvesting is not obtainable. In some areas it is said to be 5 years, and in some six years. They are collected by cutting at a distance of 5 to 8 cms from to ground carefully unwinding from the trees on which they support themselves. This is not an easy task. The sheaths are full of thorns and a slight carelessness results in the snapping of the stems, reducing their values. Another practice is to drag them down from the trees which support them. The sheaths are removed with a chopper.

In the area around North Kanara the right time for the harvesting is considered to be when the leaf sheaths of the lowest portion start loosening and it becomes barren of leaves, this is when the plant becomes about 6 years of age. To be fit for cottage industries canes should be cut only after they reach their sixth year. They remain fit for only 4 to 5 years thereafter.

Even ordinarily canes contain large quantities of water. Allowed to remain so their durability is lessened. They are attacked by fungus growth. So they are bundled together as soon as harvested and stalked vertically with their bottoms down. In some countries they are rested on the ground, in some they are hung in that position. The water thus drained away. In the rainy season, the stems contain even more water and take a much longer time to dry. Micro-organisms attack when the stems contain large quantities of water. The canes lose their strength and beauty. Hence, harvesting is not done during rainy seasons. April and May months are preferred for harvesting.

Commercial agencies divide canes into three grades, on a consideration of their thickness and their end use. The slenderest i.e. those whose thickness does not exceed that of an ordinary pencil are called pencil grade. Those with stems between the ranges of 6 and 25 mm are called medium grade. Thicker ones are called thick grade.

The topmost one-third of each grade is not durable. That portion falls an easy prey to insects and organisms. Hence, it is not used for the manufacture of articles requiring strength and durability, such as furnitures. But it is not altogether useless. It is used for manufacture of flower baskets, flower vases, wicker

work, tiffin baskets etc. Its colour is more pleasing. It is highly flexible and sufficiently elastic.

The lowest-third portion in all the grades is an extremely hard materials and the least attractive. It cannot be bent easily. It is not elastic, hence difficult to strip and weave. But it is very strong and highly durable, being light at the same time. Insects, fungi, germs and similar organisms do not attack it. So it can be used for the legs and arms of chairs, tables, teapoys etc., and when sufficiently thick for walking stick.

The middle portion is the most useful part in all the grades of canes. It combines all the good qualities of the top and the bottom portion and does not share their bad points. Hence, it is the most popular and fetches the highest price. The middle portion of the medium grades can be used for nearly all the purposes.

After classifying as above, each grade is cut into lengths of 2 to 3 metres to facilitate transporting and then bundled and stalked to drain away the water in them and then dried.

A few canes of the medium and thick grades are not cut but are dried properly and then wound into rings. In their entire length, they can be used for hauling logs, drawing cares (Raths) in which idols are taken in procession, and for suspension bridges over mountain streams. For this last purpose two or more stems are bound together. One of the ends is tied to a tree on one bank of the stream and the other another on the opposite side. Such bridges are known to last for 3 to 5 years depending on the heaviness of the duties they are made to perform.

Canes being remarkably pliable strong and long find many uses. Some species like *Acantha spathus* and *extensus* yield canes that substitute ropes and cables and can be used for suspension bridges. They are eminently fit for wicker-work, baskets and similar containers. *Acanthus speathus*, *Andamanicus*, *Latifolius*, *Rotang* and *Tenuis* are also used for those purposes. The thicker among these are used for ribs (warp) and the thinner for the rounds (weft). The cane basket industry is well developed in Nagaland, Manipur, Mizoram, Assam, Arunachal Pradesh, West Bengal, Karnataka and Maharashtra.

The most extensive use of cane is however in the furniture industry for seats and backs of chairs and sofas. They are also used for making wickerworks. For this purpose the canes are split, the outer layer is carefully removed, cut into flat strips and woven. The splitting is done by hand in India. the stems of rotang and tenuis can be split with great ease. They are favourites with furniture makers. The thicker canes *acantha spathus*, *Latifolia viminalis* are used for furniture frames, walking sticks, polo sticks and umbrella handles. *Pseudo tenuis* are used for ammunition boxes.

The pith left over is cut into strips and used for furniture, sieves and mats. The refuse from the splitting is ground and sold as crushed cane for stuffing and packing. The pith is also used for making rough cordage, matting, fibre trunks and also for a variety of other uses

The raw materials for these industries are canes and nails. The important tools are moulds, to give shape to canes by bending whenever thick and medium grades are to be used, clamps, rollers, hand saws, knives, chisels, files, pliers, screw drivers, heaters and foot rulers. All establishment do not employ all of them

The process of manufacture is simple. Canes are first of all split up, then dried if necessary if they have not been dried and cured already. Thicker varieties do not yield to bending beyond limit. They are required to be heated at certain points to a certain extent. The next process is to prepare the framework. Medium grades are employed for this work. The regular weaving is done with strips prepared from pencil grade. The weaving is in attractive designs for artistic work. Rarely though, the cane are painted - this is when the canes leave something to be desired.

The manufacture of chairs from canes is an expanding industry. Cane chairs are popular for four reasons (a) they are very comfortable to seat upon (b) they can be made into any shape and size (c) they can be withstand rough uses. They do not break (d) They are light and can be moved from place to place inside the house and outside the house - in the courtyard and in the gardens. They are popular because of the combination of toughness, strength, pliability and elasticity.

The raw material for cane chair industry are thick grades for arms and legs, medium grades for the warp and pencil grades for the weaving. The thick and medium grades are sold by their lengths and pencil grades their weight.

The work is more or less akin to carpentry except for the weaving part. The skeleton or the framework is prepared first. The warps are fixed to it next. This is done by nailing. But nails cannot be depended upon to hold the canes together. So narrow strips of cane are used to tie them together as a supplement to the nails. The weaving is done after it. If necessary the chair is painted.

Light portable chairs with a framework of iron bars and back and seats of cane work are becoming popular nowadays. The manufacture of these chairs is simple and can provide employment in their own homes.

What is stated about bamboos as raw material for basket applies for canes. The difference lies in this : bamboos are made into strips before weaving, but canes are used as a whole or made into skins in the manufacture of furniture and other finer classes of work. Where strength and long life are required, cane is the material. Baskets for carrying heavy commodities are usually of canes. Medium grades are used for weaving them. Where beauty and neatness are the considerations, pencil grades are employed. Hand baskets are woven from pencil grades. Each requires a kilogram or little more. Often strips from medium grades are also used. However, they do not look so attractive and do not get that price. Picnic baskets with lids requires two kilograms of pencil grade. Attractive flower baskets require half a kilogram of pencil grade or 5 metres of medium grade. Trays require half a kilogram of pencil grades. The price may be anything for an article of special beauty which catches the eyes of the tourists and his purse permits.

Wickerwares fall under the group of baskets. Only they are intended for better purposes and are more artistic. The most commonly manufactured wickerwares are flower baskets, baskets for novelty shop sales, women's summer hand bags, laundry baskets, tiffin baskets etc. They are in all sizes and shapes

Skilled wickherware makers take pride in the closeness and evenness of their sewing or weaving as well as in the over-all balance and symmetry of their finished products. Intricate designs are the evidence of the makers manipulative skill. The introduction of designs into coiled work is especially difficult, because he must have the entire design in his mind before he begins work.

Dyeing is also common. Four colour effect is achieved by dyeing some of the reeds black, some yellow, some red and by leaving some with their natural colours. Only vegetable dyes are used. Striking effects are obtained by using materials of different colours. Some decorations are with shells, feathers beads etc.

The fleshy mucilaginous sweet pulp of the fruits of Rotang variety and few other species are edible. They are substitute for betelnut. The young tender shoots of some species e.g. rotang are used as vegetables. The dried seeds or rhasi are powdered and applied for ulcers. The roots of rotang are used as medicine for dysentery and biliousness and as tonic. They are also used in veterinary practices as apertinent. The tender leaves of travancoricus are used in dyspepsia, biliousness, ear troubles and as anthelmintic. Root is effective for winery trouble and dissolves kidney stones. Fruit extract is used as vaginal douche. It is effective to cold, fever etc.

There is no doubt that cane is one of the most useful species of plants. Since it is difficult for cultivation, we may at least think of proper cane management.

CHAPTER 13

AGNIMANTH

The term agnimanth is derived from the belief that man invented fire by rubbing the wood of this plant. It was frequently referred to as Arani and its wood as Sami in our epic texts. It belongs to Verbenacea botanical family and there are about 40 species in Premna genus. Most popular being Premna latifolia Roxb and Premna integrifolia Linn. The first one being a large plant and the second one is a small one. In Bengali it is called Ganiyari, Though found growing wild all over India, their concentration are generally near the sea shore or the land having large net work of rivers. Other few species found in India and oriental world are Premna divaricate will. Premna parasitica blume and Premna trichostoma Miq.

Fruits of divaricate variety are reported to be poisonous. Leaves are edible while the leaf-poultices used for headache. Parasitica variety is used medicinally for fever. The common varieties such as latifolia and integrifolia yields alkaloids such as premnine and ganiarine. It also yields antibiotics such as Staphylococcus aureus, bacillus subtilis streptococcus pyogenes etc., all of them being active against gram positive organisms.

In Ayurved few habits such as greed for food, fond of sleeping during the day, reluctance to work or habitual lazy etc. are also considered as diseases. It is said this plant is the answer to such diseases.

The leaf of this plant is applied externally on swelling due to injury. The juice of the leaves (about 3 to 4 tea spoon full) if taken after warming activates kidney, normalises urine and brings down the swelling. Water boiled with bark and leaf of this plant cures hepatitis. Dried powder of its bark is extremely effective for heart diseases. Both bark and leaf assures proper bowel

movement. Water boiled with stem and leaf if consumed ensures proper period and keeps the figure slim. Powdered bark if consumed regularly controls greed on food. Bark, leaf and root are extremely useful for urinary troubles. Bark powder if consumed reduces cholesterol while leaf powder reduces blood sugar. It has the capacity to increase metabolism of the muscles. It has the capacity to activate pancrease liver and kidney.

The plants usually grows wild and are considered non-commercial. Obviously it is the victim of both afforestation and deforestation. That is the reason its eradication is almost assured unless we are alert from today. If we have to eradicate, let us eradicate diseases but not the medicines.

CHAPTER 114

DARU HARIDRA

In Sanskrit Daru means wood and Haridra means yellow. Therefore Daru Haridra means a plant with yellow wood. It is often referred to as key for hepatitis as it has the capacity to cure almost all liver diseases. About 5 to 6 species all belonging to Berberidaceae botanical family of Berberis genus. All these species are found growing in high altitude between the altitudes 1000 to 4000 metres from Sea level either in Himalaya or sub Himalayan region or Nilgiri hills. These trees grow upto a height of 1 to 7 metres, the branches are usually slanting towards the ground, small thorns at the end of each branches and edge of the leaves have teeth. Flowers appear around February and March while fruits during April to June. Wood of all these plants are yellow.

The species found in India are *Berberis aristata* DC., *Berberis asiatica* Roxb., *Berberis lamberti* Parker, *Berberis thungabergii* DC, and *Berberis vulgaris* Linn. Out of all above the first two species are considered to be highly medicinal although other species are also used as medicines.

Bark of aristata variety contains two alkaloids such as palmatine chloride and mixture of palmatine and berberine chlorides. Berberine is not Vibriocidal but prevents the death of cholera infected rabbits when given early and is better than sulphaguanidine. Root, bark and stem of asiatica variety yield berbamine, berbarine, palmatine and jatrorrhizine from their extracts. Both the above varieties yield alkaloids such as berbarine, and oxyacanthine, sterols such as α - Sitosterol and β - sitosterol besides unidentified gummy substances containing nitrogen. Roots of Lamberti variety contain alkaloids Oxyacanthine, berbamine, berbarine, palmatine, jatrorrhizine,

lambertine and berlambine. *Thuribergii* and *vulgaris* varieties yield all the above alkaloids besides magneflorine picrate.

These plants are called "Pili Lakdi" in Hindi, "Darhild" according to Yunani scriptures and "Parjanyahari" in ancient Sanskrit. It is reported that wherever it grows, fog is usually absent at least around the plant even during winter at high altitude places.

The fruits are round and looks like dried grape (*Kismis* as we usually call) and is extremely sour. It is called "Jerix" by Yunani hakims, and used extensively in Yunani preparations. Flowers have nectar hence beekeeping industry may be planned wherever it grows particularly since climate remains moderate during flowering seasons. The wood has capacity neutralise snake poison hence is effective in case of snake bites. Water boiled with this wood effectively controls blood sugar.

Bark boiled in water till the water becomes thick if consumed cures both Menorrhagia and Leucorrhoea. Leucorrhoea can also be cured if paste that comes out by rubbing moist wood against stone be consumed. Solid extract of bark and root together is used for various diseases. This prepared by boiling root and bark together with eight times of its weight of water till it becomes concentrated. The solid extract when consumed with butter cures bleeding piles. This extract after diluting with water may be used for washing piles. Solid extract of wood fried with oil if applied cures pimples. Crushed wood, crushed with urine of cow if consumed cures hydrocele. Crushed wood soaked in hot water for 4 to 5 hours if consumed in every 4 hours cures eye diseases. In case of liver diseases its root acts miracle. The moist wood rubbed against stone yields a paste. This paste when consumed with honey cures all liver disease even hepatitis. It is said that two alkaloids berberine and oxyacanthine present in the root acts on liver to relieve it from all troubles.

The plant grows wild hence is a victim of afforestation, deforestation and jhuming. As these plant decreases fog increases inviting accidents and we get less and less medicinal herbs.

CHAPTER 115

BABLA

During ancient vedic age drinking wine and consuming beef was pretty common amongst Aryans, the ancestors of Hindu Indians. Subsequently it was noticed that both these items caused a lot of health problem, hence subsequently, consumption of wine and beef was discouraged by bringing taboo through religions so that people shall obey out of fear. Nevertheless the ill effect of above two items were neutralised during those periods with the help of a herb called Barbur which is now called Babla in Bengali while in Hindi belt it is called Babur, Babul and Kikar depending on various places. In botanical nomenclature it is called *Acacia arabica* Willd., belonging to Leguminosae botanical family.

The tree is the native of desert areas but now grows almost everywhere in India as the plant has capacity to adapt almost all type of climate and soil conditions. On an average the tree grows upto the height of 5 to 6 metres but occasionally 8 to 10 metres high babul trees are also noticed. Leaves as small, oval like those of imlee tree. The plant is full of thorn like any other plant of desert origin. The thorns are usually thin but sharp like stationary pins. Infact it was used as stationary pins in war camps during second world war. Fruits are elliptical, white about half an inch wide and half an foot long hairy. There are 8 to 10 seeds in each fruit. Timber is very strong. It is used for manufacture of bullock cart wheels and ploughs in West Bengal and Bangladesh. The bark and the wood contain tannins and used extensively for tanning hides in India.

The plant yields sucrose, tannin, enzymes and auxins. Seed contains fatty oils but quantum that yields or the fatty acid composition is not known. Leaves yields essential oil and the

thorns are believed to be poisons. But various parts of this plant is considered to be highly medicinal.

Water boiled with 3 to 4 gms of leaves with a little sugar given to patient having mild amoebiasis. Dry leaf, crushed into powder is used for dressing wounds. Water boiled with leaves of babul may be used for dressing the wounds. This prevents the wound tending towards septic. In case of mumps babla leaves with fried sand and Katha (the gum of another plant of acacia genus usually consumed with betel leaf) is applied externally while hot. This also cures other throat problems.

Semi solid extract of root bark, bark, leaf, flower and fruit has various medicinal applications. It is prepared by boiling all above at equal proportion by weight with eight times by weight of water till it becomes semi solid blackish mass like coal tar. This is usually kept by adding preservatives. The solid extract cures problems of gum by application. By applying diluted semi solid extract on the places of sprain the pain as well as other problems vanishes. This semi solid extract may be used with warm water for gargling in case of any throat trouble including injury. By injecting diluted semi solid extract through vagina, as douche white discharge or leucorrhoea can be cured. Besides all above this semi solid extract can be used for various other purposes.

The gum of babla tree, and aqueous extract of leaf and bark are used effectively in case of diabetes, insipidus, diarrhoea, pimples and septic wounds. Nursing mothers usually faces the problem of breast or breast nipple injury when her child sucks unevenly. Water boiled with bark of babla may be applied externally for such problem. Babla fruit ground into powder if taken with sugar or sugar candy not only cures cough but acts as a good expectorant too. The solid gum secreting from its bark has many medicinal uses. Fried gum with sugar is a sweet dish in Rajasthan which is supposed to increase semen concentration and sex urge. This gum and sugar diluted with water if drank as a beverage is good for any problem of blood sugar. Similar beverage if added with the juice of leaves of *Oxalis Corniculata* cures troubles during urination. Battisha is a word derived from Hindi word *Batrish* meaning thirty two. That means a dish prepared with thirty two items. A sweet dish in the form of

laddu is very popular in Haryana and Punjab is prepared out of babla gum fried in ghee and 31 other items such as bansha lochan, Akhrote, Pista, etc. This is not only a sweet dish but considered as tonic and must be consumed both during pre and post natal period.

It is unfortunate that even though this tree that gives so much, still grows wild. Due to introduction of chrome tanning and synthetic tanning, the demand as tannin is diminishing. As medicine except for local doctors it has no value, as we prefer quick relief knowing fully well that we shall have to suffer from drug resistance during near future. We must think of preserving this plant, propagate it so that we shall have assured renewable source of medicines ensuring better environment.

CHAPTER 116

PRASARANI

A creeper that is usually planted in almost every kitchen garden in Eastern India notably West Bengal, Orissa, Bangladesh and Assam inspite of it bad odour is Prasarani. During ancient Indian days it was called in various names such as Bhadra, Sarani etc. In Bengali it is called Gandal or Gandha Bhadule while in Oriya it is called Pasaruni. It is also called Putigandha due to its bad odour. In botanical nomenclature it is called *Paederia foetida* Linn., belonging to Rubiaceae botanical family. Also belonging to same genus and botanical family is *Paederia tomentosa* Blume, which can also be used for similar purpose but having less impact of bad odour. This is known as chhoto Gandal in Bengal. However, we are limiting our discussion here in foetida variety.

This creeper yields essential oil, sterols, straight chain fatty alcohol and various alkaloids. The bad smell is due to the presence of methyl marcaptan.

An important dignitary arrives with announcement and appearance of pilot cars with siren. Similarly a fox announces arrival of tiger. Before we actually attacked by any disease, similarly an indication arrives prior to the appearance of the disease like that of dignitary, rain and tiger. For example before we are attacked by fever, we suffer from cold and cough. Loss of appetite indicates either malfunctioning of liver or any stomach ailments. Prasarani has its application right from pre-disease stage.

By external application and consumption at a required dose of Prasarani (doses has to be decided on the condition of patient) often restores paralytic patient to normalcy. Prasarani leaves crushed into paste, mixed with til oil if applied externally

relieves pain due to muscle pull or vein shrinkage. Three to four tea spoon full of juice of Prasarani leaves if taken with raw milk ensures proper urination. The juice of leaves if taken with til oil, early in the morning before breakfast cures arthritis and rheumatism. The juice of the leaves if consumed with garlic by chewing together relieves pains due to rheumatic affections. Two to four tea spoon full of hot juice of the leaves if taken with 9 to 10 drops of honey reduces, often cures amoebic dysentery. For any stomach trouble of or indigestion a dish prepared with prasarani leaves with raw banana shall not only serve as a food but shall also act as medicine. However too much use of Prasarani leaves may cause constipation hence it should be ensured that its doses should be ensured properly or should be consumed with leaves of *Centelia asiatica*. Prasarani can be used for various other stomach ailments. It also relieves pain due to joints if taken with raw turmeric. The juice of the leaves if taken with hot and concentrated milk increases semen ejaculation, increases concentration of semen and ensures satisfaction during sexual intercourse.

Traditionally this creeper was a must for our kitchen garden. As we continued to imitate west, and continued with urbanisation process, traditions were foregotten so also Prasarani. Synthetic drugs came handy than herbal drugs at our door step. We are obviously not moving towards right direction since renewable medicines are vanishing quickly. It need not be explained but to prevent such obviously ill implications like any other herbs Prasarani should be propagated.

CHAPTER 117

CHANA

Chana is a very popular lintel crop all over India used as food for horses and men alike, as medicinal herb and to maintain our beauty. It is cultivated not only for above purposes but also because it helps in increasing soil fertility. It is known as Chana all over India, Chanak in Sanskrit, Chhola in Bengali and Assamese. It belongs to Leguminosae botanical family and known as *Cicer arietinum* Linn in botanical nomenclature.

The yields oil soluble vitamins such as vitamins A, D and E, Acids such as Oxalic acid, malic acid, acetic acid and other acids, Amino acids such as arginine tyrosine, lysine, cystine, tryptophane, besides Carotenoids, lecithin, phytin, saponins, bichnin a, bichanin B and bichanin C-Isolation of three new crystalline glycosidic fractions are reported. Lower melting fraction of Chana yields 5, 7 - dihydroxy - 4 - methoxyisoflavone and higher melting fraction yields 7-hydroxy-4-methoxyflavone. It is considered as one of the high protein food.

Dehusked Chana is used for cooking lintel or dal which is one of the main dish in our menu card often consumed with bread or rice. Crushed powder of dehusked Chana is consumed in Bihar as Chhotu and considered as poor mans protein. This powder is also considered as cram for vegetarian fry or cutlets. Chana with husk is also cooked as principal or side dish often considered popular dish all over India. Boiled Chana often taken raw with a pinch of salt or Chana after boiling is fried with onion, chilli and salt is often taken either as breakfast or as evening tiffin. Chana left overnight in a glass of water sprouts, and this sprouted Chana is not only a source of Vitamin C but increases body resistance. It also decreases blood and urine sugar. Those having low sugar must take either with molasses or sugar or honey.

Chana itself is extremely effective cosmetics. Powdered dehusked Chana made into paste is traditionally used as soap cum cosmetics in India. By applying on our skin before taking bath, it not only cleans but makes the skin healthy with dazzle besides improving the complexion. In addition if Chana soap is consumed it further improves the skin surface.

Chana is highly medicinal. Chana soup if taken regularly cures urinary complaints even the burning sensation during urination. The soup if gargled cures gum and teeth trouble. Chana with its husk boiled in water if taken along with the water gives relief from breathing troubles. Chana crushed with water if applied externally cures pimples and other skin diseases. Chana leaves with its stem crushed into paste if taken with salt cures troubles from indigestion, burning sensation due to acidity, hyperacidity and constipation. Dehusked Chana powder must be taken regularly to give physical and mental strength. Chana soup may be given to children suffering from fever and diarrhoea. Chanakamla is a wonder liquid used for various diseases with various herbal combinations. A fine cloth drawn on Chana plant early in the morning so that it rubs through and absorbs the dew deposited on Chana plant. The dew is then squeezed out to get an acidic fluid which is heated to make a concentrated liquid of sour taste which is called Chanakamla.

Fried omelette prepared out of dehusked Chana powder if taken with salt and ajowan is not only tasty but ensures appetite, removes constipation thus ensuring healthy life.

Chana appears like a brush do have nectar. Hence beekeeping industry can be planned during its flowering season. Chana honey has more of levulose than sucrose or glucose and have sufficient minerals and vitamins. The plant yields fibre. Fibre in main stem is stronger and light in colour and can be extracted by retting method. However it is a fibre with smaller length and yield of fibre is low.

It is a wonder plant of India.

CHAPTER 118

ARHAD

Arhad is one of the most popular dal or lentil all over India. In South India, sambhar the most popular dish is prepared out of it. In North Indian particularly in the cow belt this is the item relished with roti or bread. Out of 56 dishes offered to Lord Jagannath in Puri dal of arhad is a must and the famous Rahani dal is the thick dal of arhad. Almost all over India this is referred to as Arhad or Arhar perhaps derived from the original Sanskrit name of the plant Adhki. In few Sanskrit texts it is referred to as Samee dhanbya which means it has the characteristics of fire symbolically indicating that it has the capacity to help metabolism of our body. In botanical nomenclature it is called *cajanus indicus* spreng and belong to Leguminosae botanical family.

This plant is usually cultivated between the cereal crops. Apart from the virtues of its products, it has the capacity to reactivate the soil after the soil is squeezed out by the cereal crops. In other word, the cultivation of this crop or rather this type of crop is a must to maintain soil characteristics. In India, although Arhad is cultivated in all the states, bulk of cultivation is in Bihar and Uttar Pradesh.

The plant is basically shrub growing into a height of one to three metres. Leaves are 5 to 7 cms long and one to one and a half cms wide. Leaves are green in one side and whitish green on other surface, that is the surface facing the ground. Its yellowish flower appears during July and August. Fruit appears during the month of November and December, are small and round having three to four seeds.

There are two types of plants are identified having same botanical name but the differentiated by the colour of the seeds

used as lentils. The red variety is reported to be more nutritious than the yellow variety. Both are protein food. They yield useful amino acids methionine but rich in lysine. Extraction of active urease is reported. Peptization of red gram protein is also reported. The plant yields two globulins such as Cajanin and sterols such as β - sitosterol and α - sitosterol. While its seeds are essential food it is considered medicinal. Above all its leaves and root are also medicinal.

Due to loss of appetite we often take less food which affects our health ultimately. Soup prepared with this lentil fried with ginger pepper pastes and salt to taste if consumed shall bring back the appetite even in case of old cases of loss of appetite. But, however, for permanent cure real cause of loss of appetite shall have to be detected and treated accordingly the juice of its leaves acts various ways. 7 to 8 tea spoon full of juice of the leaves heated and taken with one spoon full of honey cure cough and acts as effective expectorant. The juice of the leaves also cures jaundice if the attack is initial or minor in nature. Only two spoon full of juice of the leaves if taken twice daily after heating relieve pain due to piles. But should be noted that intensity of pile increases due to constipation for which soup of lentil fried with ghee should be taken regularly. In case of burning sensation felt in hand and legs, the juice of the leaves may be applied externally. In case injury on the tongue, the leaves be chewed and spat. In case of blood vomiting (other than for TB), two to three spoon full of juice of leaves if taken after heating is very effective. It will be more effective if taken with 15 to 20 drops of honey. However, one should take watery portion of the lentil regularly during the period of above course. The plant is extremely effective in case of diabetes. Just taking juice of the leaves the sugar can be controlled. The aqueous extract of root bark is very effective in controlling both blood and urine sugar. Water boiled with crushed root with one or half a tea spoon full of honey (with high luvlose content and negligible sucrose or glucose content) is very effective. During the period of above treatment soup of the lentil is must in the menu card.

Nutrition point of view there is no doubt that it is a nutritious food. But due to less amount of essential amino acid its biological value is less ranging around 60 to 65. Protein efficiency ratio is moderately high that is around 1.5 to 1.7.

The flower of the plant has nectar. Hence beekeeping may be planned during its flowering season. The honey has appropriate fibre which can be extracted by retting method as by-product.

On the whole this cultivated crop has many virtues but we only utilise a fraction. Not only that its cultivation be propagated but also its use should be made efficiently.

CHAPTER 119

ANAR

In our ancient text a number of plants of *Punica* genus and *Punicaceae* botanical family often referred to as Dadimba which are called Dalim in many places in India. Although modern botanists describes these plants are of African origin, but the fact that it existed in India even during pre-vedic era we cannot definitely say about its real origin. However fact remains these plant species grows well in India, other South Asian countries, West Asia and Africa. In Indian texts, these plants were classified according to taste of the fruits. The best out of all Dalim plant in Bedana (meaning absence of grains) or Anar (in Hindi) which is known as Pomegranate in English. In batanical nomenclature it is called *Punica grantum* Linn., belonging to same botanical family as mentioned above.

Anar fruit yield 15 per cent Sugar as fructose, pectin, monaid etc. Peel of the fruit and bark yield 22 to 25 per cent tannic acid and root bark yield 20 to 25 per cent Punico-tannic acid. Various parts of this plant yield alkaloids such as psendopelletierine, pellatierine, isopelletierine and methyl-pelletierine, besides mannitol and sobitol. It has sufficient vitamin B activity. In fact bark contains all the alkaloid as mentioned above. Bark also contains betulic acid, peel of the fruit ursolic acid and leaves contain both. In addition the bark contains three other basic compounds. The alkaloid isopelletierine has anthelmintic activity. Root bark is also anthelmintic which is tested against *Taenia canine*. Extraction of bark is used as a tapeworm helminthicide and also effective in hymenoleitidosis. Fruit juice contains both vitamins B and C if taken fresh.

The plants grow upto the height of 3 to 5 metres. Both female and male flowers appear. The flowers have nectar and sufficient

honey. Therefore beekeeping industry may be planned during its flowering seasons.

As mentioned above both bark and peel of the fruit contain high tannin. Hence they can be effectively used for tanning hides. If the tannins can be isolated, we can use this extracted tannin more effectively and economically.

All the plants of this species are storehouse of medicines of many type of diseases. Children commonly suffers from liver diseases. Mosts effective medicine bring 2 to 4 grains of root bark taken with 1 to 2 tea spoon full milk and 2 to 5 drops of honey. It should be taken in the morning once a day. However diet as prescribed should be followed strictly. Fruit juice with honey ensures increase in intelligence and slimming of figure. Anar flower with white sandle wood paste and milk if taken cures Leucorrhoea within a day or too. For nasal bleeding juice of flower may be sucked in through the nose. Root bark powder if taken with water removes intestinal worm, particularly tape worm. Fruit juice if taken with Ghritakumery pulp ensures sound sleep and activates heart. The flower has many utility in gynec diseases. In case of dysentery bark boiled in water or fruit peel boiled in burely ensures cure even in case of blood dysentery. If either of this treatment is repeated, it often cures chronic dysentery. Paste of flower in goats milk acts as expectornat in case of children. The juice of flower if consumed stops blood vomiting instantly if such vomiting is due to liver trouble. Fruit peel acts wonderfully in case of diarrhoea. Peel of fruit contains tannin which restricts bowl movement. Dust of the peel if taken with honey or semi solid extract of the peel if consumed acts almost instantly. For those who suffer from diarrhoea associated wth drops of blood and indisation the powdered fruit pulp may be with goat milk. Leaves boiled with goats milk or juice of the leaves taken with honey also ensure cure of blood diarrhoea. Fruit juice of sour variety taken with salt and honey brings back normal appetite. In case of chronic indisation fruit juice may be taken with diluted curd and salt.

The plant of this genus although grows all over India are rarely cultivated. It grows wild without much care often as avenue plant. As a result it often become difficult to get its fruits or other part of one place for commercial use. Inspite being as

plant of India we often import its fruits from Afghanistan. The reason for reluctance to go for commercial plantation being, it is yet to be exploited commercially even though having so many virtues. We must think of scientific management of this plant for our sustainable growth.

CHAPTER 12

DHATURA

Dhatura is a wild grown shrub and is popular as part of rituals for worshipping Lord Shiva. It was often used as a poison to combat enemies. The fruit if taken above certain quantity causes mental disbalance. It is also used as ingredient to add additional intoxication to bhang or siddhi. Since the shape of its flower resembles a bess, it is also called Ghantapuspa. Since there are thorns all around its fruit, it is called Kantaphal. No animal or bird touches this plant. The plant, leaves or the fruits are greenish, seeds are ash coloured. There is another plant of same genus whose plant, stem, part of the leaf and flowers are violet in colour. This plant is called Krishnadhustur or Kanak Dhutra. Utility wise both the plants are identical. In Hindi Dhatura is called Dhature, Dhura or Dhatura. In botanical nomenclature it is called *Datura metel* Linn., belonging to Solanaceae botanical family.

Various parts of this plant yields vitamin C, alkaloid such as hyoscyamine, hyoscine, atropine, scopolamine and norhyoscyamine. In addition it contains fixed oil and allantion. Roots thicker than 0.5 cm. give 0.28 per cent of alkaloid and thinner than 0.5 cm., between 0.13 to 0.15 per cent. Leaves contain the maximum percentage of alkaloid, mainly hyoscine. Economic source of hyoscine from plants fed on organic N-compounds. Drying of leaves have no effect on their alkaloidal content. Size of leaves also have no effect on their alkaloidal content. Maximum alkaloidal content however is noticed during winter, particularly in leaves. Flowers and herbs also contain alkaloid such as hyoscine and hyoscyamine.

Dhatura is not only poisonous but also an antidote for poisons. In case a person is bitten by a mad dog or jackal 1½ gms of dhutra root crushed together with 5 gms of root of

Boerhaavia repens may be drunk with chilled milk. The root is also used appropriately with other ingredients like rice, milk, sugar or candy for lunatic patients. In case of snake bite or any such poisonous bite dhatura root with haldi and Sirish flower may be crushed together and applied externally.

Baldness on our head often appears due to fungus infections. Such baldness often appears in scattered manner. In such cases of juice of the leaves of dhatura is applied externally it has immediate impact. Two to three drops of juice of the leaves if taken with milk drives out the intestinal worms. In case of breast pain hot fomentation of haldi and dhatura leaves gives relief. Three to four drops of black dhatura leaves if taken with cured cures dysentery. Dry leaves of black dhatura if smoked with basak leaves relieves asthma. By rubbing leaves of dhatura with lime an alkaline juice comes out. This if applied externally relieves back pain or shoulder pain.

Traditionally we use a oil called Kanak oil which is a often sold in the market commercially. This is manufactured with the help of dhatura only. A kg of mustard oil is heated till it boils should be cooled. To it 2 kgs of juice of dhatura leaves with stem is added slowly. After allowing it to settle about a kg of water is added and heated till entire moisture is evaporated. This oil is then filtered and kept as Kanak oil. This oil is applied externally in case of cracks appear in the feels and in skin diseases. It is also used as ear drops in case of ear trouble and pain. It can be used as massage oil for headaches or bodyache. Juice of dhatura leaves with mustard oil is applied externally in case of rheumatism and with ghee in case of tumours, boils or pimples.

Since the plant is poisonous in nature one has to be careful while using. The doses has to be decided by professional knowledgeable vaidsar Ayurved.

This plant grows wild all over India often as hedges since animals avoid them. Obviously it is a victim of land clearing, urbanisation or otherwise. Since neither commercial cultivation was attempted nor commercially exploited, its virtues are not being utilised properly. At least a thinking process may start now.

CHAPTER 121

ANANTAMUL

Anantamul is perhaps one of the most widely used medicinal herb in Indian herbal system which is now being recognised even in modern medicinal systems. This creeper grows almost all over India but rarely cultivated. However shape of its leaves varies slightly from place to place. Since basically its root is medicinal, it is widely known as Anantamul all over India. In botanical nomenclature it is called *Hemidesmus indicus* R. Br and belong to *Asclepiadaceae* botanical family.

The dried roots are medicinal and constitute the *Hemidesmus* or Anantamul which is official in Indian Pharmacopœia. The plant yields essential oil, 2-hydroxy-4-methoxy benzaldehyde sterols, glycosides, saponins, resin acid and tannins. β - sitosterol, α and β - amyrins, lupeol, tetracyclic triterpene alcohols, resin acids; fatty acids, tannins, saponins, a glycoside and ketone are present in the roots. In our ancient literature this creeper is often referred to as Sheriba.

This root acts wonder in case of asthma, and eczema (basically the two are same disease differing in expression). About 3 gms of anantamul crushed and diluted with water and rock salt if taken twice daily cures the both. Anantamul with ghee acts as deoderant if applied externally throughout the body. Anantamul powder taken with hot milk and sugar candy adds glamour and benty while ensuring proper apetite. If milk be boiled with milk and curd be made with this milk, the curd if consumed shall be useful for piles. Dried powder of the root is consumed in case of dry coughs. Root powder with honey cures dysentery if consumed. Solid extract of the root is applied externally in case of insect bites, ring worms, injuries or sceptic wounds. In case of injuries on tongue with the sheep milk is

applied. The root is supposed to clean the blood and maintains consistency in blood pressure.

The plant grows wild but not being used except the traditional vairs. As the vairs becoming the vanishing tribe, the importance of the plant also vanishing. Day by day it is becoming a victim of urbanisation, deforestation and modernisation. Propagation of this plant shall only ensure sound future health with so much virtues.

CHAPTER 122

BHRINGARAJ

A wild grown creeper growing almost all over India both in tropical as well as in temperate climate is Bhringaraj, which popular all over India as a herb which almost all diseases connected with head. That is perhaps the reason it was referred in our ancient texts as Shirastran markab. As a herb it is known as Bhringaraj in almost all Indian languages though the plant is called in various names. In Hindi it is often called Pila bhanga. In botanical nomenclature it is called *Wedelia* *Calendulacea* Less belonging to *Compositae* botanical family. Another plant of same genus and family is *Wedelia* *beflora* DC., which was discussed separately earlier. However, although found all over India, bulk of its growth are found in Assam, West Bengal, Bangladesh, Tamil Nadu and Kerala.

Entire plant is considered as medicinal herb. The plant contains alkaloids such as ecliptine and nicotine, steroidal constituents and fatty acids. Expressed juice of herb contains oil soluble black dye, 11.2; waxy compound 29.7; phytosterol, 3.75; carotene, 1.14; chlorophyll, 3.75; resin, 44.95; CHCL₁ extract (resinous mass), 27; germ, 80; total sugar, 1040; tannin, 220 and saponin, 500 mg besides siliceous materials; inorganic salts, pectin, lignin, mucin and cellulosic substances.

The creeper gives a yellow flower that comes between rainy season and winter. Since it has nectar, and its season of appearance is usually favourable, beekeeping industry may be planned. The herb can be usefully utilised for manufacture of oil soluble dye; by isolating the various compound it yields, they can be used as intermediates and the entire plant can be used for manufacture of pulp and paper. Paper can also be manufactured after isolating most of the organics it yields.

Every part of this creeper is medicinal and cures many diseases either by external application or by consumption. The dry powder of the leaves is used as tooth powder cures almost all troubles of teeth and gum while ensuring proper strength of the gum. Semi solid extract of the leaves is also useful for gum. Even for chronic hyperacidity and indigestion a spoon full of juice of leaves taken twice daily ensures cure. About 25 to 30 drops of juice of the leaves taken with goat milk ensures relief of dysentery even chronic cases. The juice of leaf taken with water removes intestinal worm. Dose however depends on age. The juice of the leaf applied externally kills lice. The dry powder of the plant used as snuff cures chronic headaches or half headaches. We may get similar relief if bhringaraj juice is used for massaging the head. The juice of the leaf if applied on head prevents fall of hair. The juice boiled with hair oil till the mass is moisture free and if this oil is applied on head regularly as hair oil not only cures headache, prevents fall of hair but is believed to be good for brain and help restoring memory and intelligence. The juice of the plant is also used as eye and ear drop. The juice of the leaf taken with milk ensures balance of proportion between red blood cell and white blood cell. The juice of the leaf is effective for curing jaundice and strengthening nervous system. The plant is applied externally in case of various skin diseases like ring worm, fungal infections etc., and restores normal colour of skin after burn injuries.

The creeper is yet to be considered for commercial cultivation. That is because it is yet to be exploited properly. The result is obvious, it remains as one of the many neglected plants in India awaiting eradication. This chapter draws attention of all elites for preventing this trend and encouraging its propagation.

CHAPTER 123

GULANCHA

A creeper that grows on another large tree or on fence, with stems about a finger thick with aerial roots, with very thin bark covering bunch of fibres and having shape of leaves like heart is Gulancha. This creeper belong to the botanical family Menispermaceae. It is often referred to as Guduchi, Gurnch, Giloi, Kandarahini or Gulancha in various Indian languages. There are three types of Gulanchas found in India. The first bearing botanical name *Tinospora cordofolia* (willd.) Miers whose stems are usually smooth. This variety is usually less bitter. The second variety is *Tinospora tomentosa* Miers whose stem is full of swollen beads and is usually more bitter. This Gulancha is usually referred to as Padma Gulancha. The leaves of Padma Gulancha is usually bigger and hairy. The third variety is *Tinospora malabarica* (Lam) Miers, whose stem is like those of padma gulancha but the leaves are not hairy. All the three varieties are more or less useful but first two varieties are considered more useful.

All these above creepers yield alkaloids giloin, giloinin, glycosides of myristic and palmitic acid, glycosides and a neutral substance, and tinosporine, the furanoid bitter principle at various proportion.

Ancient Indian medicinal texts. Charak Samhita describes use of this plant for treatment of fever, jaundice and liver diseases, blood vomiting and diseases of breast. Susuruta describes its use in case of filariasis, arthritis, piles, diabetes and leprosy.

A preparation out of gulancha that can be preserved is that white crystalline residue out of juice of gulancha plant, particularly stem. This is prepared by crushing gulancha in water and the liquid extract is taken out and crystallised slowly

by sun drying. This is often referred to as gulancha sugar, though it is not sweet. This sugar with milk cures urinary trouble. For physical weakness, this sugar may be taken with ghee. In case of weakness felt on head this sugar may be taken with milk.

The semi solid extract of gulancha if taken with appropriate doses removes intestinal worms. Some persons grow bulky despite of minimum food intake hence leave no scope for dieting. In such cases, they are to take semi solid extract with honey regularly. Gulancha is good for preventing vomiting due to liver failure. It is extremely useful in case of psoriasis both for external application as well as for consumption. Gulancha in general, padma gulancha in particular is useful for diabetes. The stem has to be crushed in water and this water to be consumed early morning, which ensures better functioning of pancreas. The stem to be used is about 10 gms. Gulancha leaves fried and taken cures fever due to weakness or chronic fever. If leaves are not available readily the juice of the stem may be heated and taken. Semi solid extract with ghee also equally effective. In case of loss of appetite, leaves may be fried and taken. In case of pains due to arthritis or rheumatism, semi solid extract of 10 gms of gulancha stem taken with milk shall ensure reduction of such pain. But usual taboo on certain food items in case of above diseases should be followed strictly. For septic wounds semi solid extract applied externally shall yield positive result. Semi Solid extract of the stem taken twice daily cures bleeding piles. If curd is prepared in earthen pots coated with juice of the gulanch stem is also useful for piles. Semi solid extract of 5 to 7 gms of gulancha taken with black pepper controls heart beats. Gulancha powder if consumed ensures digestion and improves appetite. Semi solid extract of the plant taken with honey cures cough. About 5 cm of the stem cut into pieces kept overnight in water and if this water be taken with sugar is helpful in case of jaundice, hepatitis and other liver diseases. The plant is useful in case of both small and chicken pox besides diseases connected with stomach and intestine.

Except manufacture of gulancha sugar, the plant is usually used as medicine as fresh. Not much efforts taken for commercial utilisation of the plant except perhaps as a part of

some patented herbal products. Even production of gulancha sugar which can be produced commercially even in a cottage scale is not attempted so far. Appropriate planning to utilise this product commercially shall help us for even growth to ensure proper health and environment.

CHAPTER 124

SAHADEVI

Sahadevi is a small shrub that grows all over India, Africa and Australia mostly in temperate and humid climate. It has less branches having green leaves with slight hairy on the surface facing the ground. Flowers appear in bunches, light violet in colour usually during autumn. The seeds are also hairy which helps the propagation of plant as the seeds are easily carried by air. This plant is called Sadeyi in Hindi, Chhoto Kukshime in Bengali, no Dankuni or Sankhapuspi in North Bengal, Coochbehar and adjoining areas of Assam, Meghalaya and Bangladesh. In botanical nomenclature it is called *Vernonia cinerea* Less belonging to Compositae botanical family. Charak Samhita described this plant as strength and life giving.

The whole plant gives the chemical constituents α - amyrin acetate, lupeol acetate, β - amyrin, lupeol, β - sitosterol, stigmasterol, α Spinasterol and KCl. The plant also yields carbohydrates and acids such as 12, 13 - dihydroxyoleic acid.

The flower yields nectar. Hence beekeeping industry may be planned during the flowering seasons. The seeds yields fatty oil which can be extracted by solvent extraction since yield is less and can be used for manufacture of soap. The stems yields short staple fibre which can be used for rough purposes after twisting as the strength is low. Fibre may be extracted by retting process.

As a medicinal plant it is wonderful. It acts wonderfully well in case of piles and filoriosis. Entire plant has to be crushed with black pepper and water and slurry to be prepared with raw milk by stirring. The watery portion of this slurry need to be taken once daily early morning before breakfast after filtering it for 21 days to completely cure above two diseases. During period of treatment consumption of fish, meat, egg, mung dal, imlee, chili

and edible oil is a taboo. Diet comprises of curd, milk and milk products, tomato etc. During old age often it is noticed that many persons become thinner and thinner and weaker and weaker without any specific reasons or diseases. In such cases, entire plant about 10 to 12 gms. by weight be boiled with water and half proportion milk till it becomes thicker. The liquid be consumed after filtration which shall restore the lost vigour. Vigour can also be restored if 10 gms of plant be boiled in water and then fried lightly in ghee and then taken. The juice of the plant warmed and taken with warm milk and sugar candy prevents head reeling and loss of memory. The juice of the plant taken in the morning drives out intestinal worm. Two spoon full of juice of the plant warmed and taken regularises menses. The juice is helpful for stomach pains, hyperacidity and other minor stomach ailments. Sometime we suffer from knee pain (not because of rheumatism or arthritis) mostly because of mal adjustment of joints. In such eventuality, hot foment given by crushed plant gives immediate relief while juice of the plant should also be taken simultaneous juice of leave should also be taken with water

The plant grows wild but often victim of felling as it is considered as useless vegetation. It is so considered since its virtues are not cultured or utilised properly. It is time now to think and propagate it scientifically and utilise its virtues appropriately.

CHAPTER 125

HASTISUNDI

Hastisundi is a small evergreen plant often referred to as Srihastini in our ancient texts. It is called so since the end stem that contains flower resemble trunk of elephant. It is also called Hatisunda in Oriya, Nagdanti in Telugu, Hatajuri or Sariyari in Hindi, Hastisundi in Bengali and Bhurundi in Marathi. In botanical nomenclature it is called *Heliotropium indicum* Linn., belonging to Boraginaceae botanical family. According to ancient Indian texts there are 76 types of eye diseases and this plant is capable of handling most of them. Modern medicinal science also recognises its impact on eye diseases.

This plant yields alkaloids such as heliotrine, and lasiocarpine, Saponins, essential oil and fatty acids. Lasiocarpine supposed to cause necrosis of the liver.

The plant grows wild all over India particularly where rainfall is in abundance. It grows upto a height of half a metre and obviously may be termed as a shrub only. Its stem and branches are hollow and soft.

Flower contains nectar hence beekeeping can be planned during its flowering season. The plant can be effectively used for green manuring.

As medicine it acts wonderfully. It can effectively used externally after trying the juice of the leaves with castor oil on joints, when it pains due to rheumatism, Swelling due to injury or due to cold hot fomentation with crushed leaves of the plant is useful. The juice of the leaves is also useful for venereal diseases. The juice of the leaves can be applied on the spots where there are insect bite or bee sting. The juice of the leaves if consumed acts as expectorant. The juice of the leaves boiled and filtered if taken with water at appropriate dose is effective in

case of typhoid. The juice can be applied externally in case of eczema. It can be used for gurgling with hot water in case of Larenzitis or Pharenzitis.

Above all the leaves after washing with hot or warm water and then the juice is taken out by crushing can be used as eye drop to cure almost all eye diseases. The juice of the root if taken drives out intestinal worms. The root is also useful for certain types of leprosy. The various parts of plant acts well in case of virus infections.

It is unfortunate that the plant is still considered as non-commercial and grows wild, inspite of so many virtues. There is still time to think to plan for its propagation and utilise its virtues effectively

CHAPTER 126

OLEANDER

Oleander is considered one of the most important medicinal plant not only in India but also around the globe. There are species of plants usually used for the purpose one being commonly called Oleander and the other as Indian Oleander. Both these species belong to Apocynaceae botanical family and *Nerium* genus. Indian oleander is called *Nerium indicum* Mill and *Nerium odorum* Soland in botanical nomenclature while oleander is known as *Nerium oleander* Linn.

Leaves of *indicum* species and *odorum* species yield oleandrin, and neriodin. Neriodin is twice as active as digitoxin and ursolic acid. The leaves also yields adynerin. Separation of cardiotonic principles resembling digitalis is possible. Dried leaf or its alcoholic extraction taken orally or by injection is an effective cardiac stimulant. As compared to digitalis, it has broader action and is less toxic.

Leaves of oleander species yield cardenolide glycosides, oleandrin, nenantin, deacetyloleandrin and adynerin. Hence application as drug similar to other two species is also possible in this case also. Various parts of this plant yields flavone glycosides such as quercetin-3-rhamnoglucoside and Kaempferol-3-rhamnoglucoside.

These species usually grows wild except being cultivated to a limited extent by various organisations producing herbal medicines. It is often seen being victim of felling since its virtues are not known to common people. Its propagation is in fact absolutely necessary being the source of life saving drugs.

CHAPTER 127

ROSE

Rose flower is not only famous for its aroma but also for its beauty. Emperor Shahjahan, famed Mogul emperor of India was symbolised with the red rose. First Prime Minister of India late Jawaharlal Nehru was moving with his famous red rose and we can not think him without his usual rose. Belonging to Rosacea botanical family and Rosa genus, there are a number of species identified by colour, aroma, size and beauty. Various species found in India are *Rosa alba* Linn., *Rosa borboniana* Sesp, *Rosa indica* Linn., *Rosa brunonii* Lindl., *Rosa ceutifolia* Linn, *Rosa damascena* Mill., *Rosa chineasis* Jacq., *Rosa multiflora* Thunb., and *Rosa polyantha* Sieb & Zuce.

The rose flowers are cultivated in France and Bulgaria to obtain aromatic oil. The main crop is *Rosa damascena* which is a red rose, commonly called Damask rose. In a small proportion *Rosa alba* Linn., is also grown. By mixing these two varieties of roses, a superior grade of essential oil can be obtained. The oil obtained from individual variety will be a lower grade.

When the rose is in budding stage, they are collected and individually it is distilled. More precautions will have to be taken to get a superior grade oil. Even before the sunrise early in the morning Rose is collected and distilled. The essential oil extracted by steam distillations has a high value. Traditionally in India, essential oil was extracted with hot water, and this diluted aromatic oil is sold as Golap water over India used as perfume, flavour or well as for treatment of eye. In Indian sub continent Lucknow and Dhaka was famous for production of rose water. Lucknow artisans were also well known for producing concentrated rose water called attars which has demand all over the globe.

Rosa centifolia Linn. is a weak rose shrub which does not develop fully. This yields less quantity of buds. Essential oil yield in this variety of rose is 0.011 to 0.43 per cent particularly those cultivated in Italy and France.

Fresh flowers of *R. indica* variety yields 0.013 to 0.15 per cent of essential oil. Composition of this essential oil is 22.1 per cent Stearoptenes, 16.36 per cent Phenethyl alcohol, 12.78 per cent geraniol, and 23.39 per cent 1-citronellol.

Essential oil from *R-damascena* variety is by far superior to all. It yields 45.51 per cent citronellol. On fractionation it yields 1 per cent ketone. It also contains geraniol. Rose flowers handled 4 to 5 hours after picking maintain entire quantity of their oil if preserved in 20 per cent NaCl solution.

Fruits of *R. multiflora* Thunb., and *R. polyantha* Sieb & Zacc yields 9.4 per cent fatty oil which can be used as edible oil as well as for manufacture of soap. Fruit pericarp yields phytosterol, quercetin, triterpenoid and β - carotene besides of course multiflorin, a flavonic glucoside having weak Cathartic effects, Flowers yields essential oil

Fruits and flowers of rose contains vitamins and minerals which can be used as edible and as tonic. Rose honey is excellent due to appropriate L/D ratio and with sufficient minerals and vitamins. It has consumer appeal too due to its sweet aroma. Hence beekeeping industry can be planned. Essential oil with appropriate doses is used for treatment of eyes and for washing eyes.

The stems of rose plant contains fibre which if extracted can be used for cordage purposes and for manufacture of ropes. The fibres can be extracted by retting method.

CHAPTER 128

PINE

Pine, the beautiful tall tree that grows wild in Kashmir, Himachal Pradesh and in entire Himalayan tract, Meghalaya and Arunachal Pradesh is a plant known for enhancing natural beauty in the tract where it grows. Belonging to Pinaceae botanical family and Pinus genus there are three or four species found in India. Pinus Khasiya Linn are usually found in North Eastern India while Pinus roxburghii Sarg and Pinus longifolia Roxb are found in Himachal Pradesh and Jammu & Kashmir.

Pine needle concentrates are sources of vitamins C and E and Carotene. Hydrolysis of the needles with water containing 1 per cent HCl or 3 per cent H_2SO_4 yields extracts containing two-third of all vitamin C.

When oleo-resin obtained from pine tree sap by incision in the bark, is steam distilled, terpeutine destills off and their residue is rosin. Though Rosin is a non-fatty material, it is acidic and its sodium salt endows solubility in the hard water and increased lathering to the soap, especially when it is prepared from the stock. Hence rosin is considered alongwith the fatty material and taken in the oil charge upto 5 per cent in toilet soap and upto 20 per cent in laundry soap. Rosin yields fatty acids such as abietic, pimaric etc., besides hydro carbons and alcohols upto 10 per cent. The properties of rosin is given below :

Properties of rosin

Specific gravity	-	1.05 to 1.0
Acid vally	-	160 (Min)
Volatile metter	-	2% (Max.)
Unsaponifiable matter	-	6% (Max.)
Colour	-	red, yellow or blue

Rosin is also used for manufacture of pheneol or phenyle, whose main ingredient is rosin soap. It is also used for manufacture of certain type of varnishes or polishing pastes. Hot molten rosin itself often used for polishing wood surfaces. Rosin is also used as mosquito repellent and often burnt to give good aroma. Terpentine is often used for seasoning of wood and for manufacture of wood polishes. It has the quality to repel white ants.

Branches of pine trees were traditional used as torches in the areas where it grows. They are also used as firewood. Rosin and terpentine contain of Khasiya variety is comparatively lower than the other two varieties. That is precisely the reason why Himachal Pradesh and Jammu and Kashmir supplies bulk of the pine rosin. Pine trees are victim of deforestation and feeling is faster in the place, where jhum cultivation is common. This is because its virtues are unknown to the people of the pine growing states.

CHAPTER 129

SWEET LOCUST

A medium sized evergreen plant that grows upto a height of one to two metres is considered native of America, but commonly cultivated in India as a roadside or hedge tree. In botanical nomenclature it is known as *Gleditsia triacanthos* Linn, belonging to Leguminosae botanical family.

The plant contains triacanthine, hypoxysin and gummy matter. Action being mydriatic, anodyne and narcotic. Heartwood contains 4 to 48 per cent tannin. Hence the heartwood itself or tannin if extracted may be used effectively for tanning hides to give comparatively hard leather fit for sole.

The leaves contain two active constituents, hypoxysin of oxytropic properties and neutral principle having a depressor action.

Mature pods, air dried, contain two colouring matters such as acramerrin and olmelin, while green pods yield a flavonoid glycoside. The volatile fraction and the juice of the pods possess antibiotic activity against *Penicillium glaucum* and other micro organisms.

Seed gives a fatty oil which can be used as a raw material for manufacture of soap, cosmetics and pharmaceuticals. Oil cake can be used as manure. The unsaponifiable fraction of the oil contains phytosterol which can be isolated both from oil as well as from oil cake.

The plantation of this plant is yet to be tried on commercial line since its virtues are not yet used commercially. An action plan should be drawn for appropriate utilisation.

CHAPTER 130

GANDHANIKULI

A small herb usually grows wild in semi humid areas is Gandhanikuli. It has become a rare species since not only that it is not cultivated but also a victim of felling, though highly medicinal. It is called Bada Chanda in Bangali and Gandhanikuli in Sanskrit while often referred to as Nakuli or Sarpakhsi also in Oriya it is called Patal garudi. In botanical nomenclature it is called *Rauwolfia Canescens* Linn. belonging to Apocynaceae botanical family. It grows upto a height of one to one and a half metre.

The plant in general contains alkaloids such as rauwolscine, reserpine, serpentine, and deserpidine, Sterols such as β - sitosterol and α - sitosterol besides fatty alcohols. Leaves yield two new indole alkaloids such as isoreserpiline and isoreserpinine. Roots are said to contain 0.8 to 1.0 per cent of total alkaloids identical to alstonin. These alkaloids produce hypotension and inhibit hypertension. Alkaloids reserpine, rauwolscine and alstonine are found in roots. Alkaloid yohimbine, serpentine and raubasine can be isolated from the roots. Alkaloids raupine, ajmaline, reserpinine and ajamalicine are also present besides isomeric alkaloids raunescine, and iso-raunescine. Serpentine also can be isolated from the roots. Synthesis of reserpine analogue from rauwolscine possessing hypotensive activity equal to reserpine.

In rural Bengal there is a lod saying that "Chhoto Chanda bada Chanda - Ki hobey tor dadi bandha?" That means if you have Chhoto Chanda (R. Serpentine) or bada Chanda (R. Canescens) there is no need to tie the rope in case of suaka bite. That means these plants do have capacity to neutralise sukae venom. The root of this plant is effectively used both externally

and by way of consumption to combat snake bite as it has the capacity to neutralise snake venom. It even neutralises those snake venoms which are neurotoxic. It is also equally effective in case of scorpion bite, rat bite and insect bite.

The extract of its root, is used for preparation of medicinal preparations needed for fever. It also acts as expectorant. In case of high or low blood pressure it is considered excellent to bring back the balance of pressure. It is also used for preparation of medicines needed for lunatic patients. It is also used for skin diseases, neurological diseases and for releasing hypertension, besides helps in better blood circulation. There are many more virtues and as the plant gradually becoming rare, we are gradually becoming helpless to combat all above problems.

CHAPTER '31

KANTAKARI

Kantakari is one of wild grown evergreen tree that grows wild all over India. In botanical nomenclature it is called *Solanum Xanthocarpum* Schrad and Wendl., belonging to Solanaceae botanical family. During its flowering season, its flowers appears in bunches either white or violet; both being the plant of same botanical name. In India however appearance of violet variety predominates. It is known by various names in India in different languages. It commonly found adding beauty of our avenues and forest alike.

The plant yields 1 per cent alkaloids which can form source for cortisone and sex hormone preparations.

In our traditional herbal system this plant has got recognition for prevention and cure of various types of poxes. Although prevention of small pox has been successfully complemented by using vaccines, there is no answer so far for chicken pox and measles. Thus small pox could be eradicated during recent past but as it is believed today the other two variety continues as before. It is said although Kantakari do not have capacity to prevent or cure chicken pox or measles, it can however can keep the diseases under check. But our scriptures says it can be used for prevention of all type of poxes it used appropriately. Chakra Dutta, the famous Indian doctor of 11th century suggested semi solid extract of 3 gms of Kantakari root and 9 to 10 grains of black pepper may be preserved and if taken at appropriate doses depending on the age shall act as prevention to all types of poxes and reduces intensity of the disease for person already affected.

Apart from its medicinal virtues, since the flowers do have nectar, beekeeping can also be planned. Its bark and root yields rough fibre which can be extracted by retting method. The

leaves can be used effectively for green manuring and the flowers are source of vitamins and minerals.

Thus the plant needs attention of our planners to include in our planning map.

CHAPTER 102

BETLE

Chewing of betle leaves is perhaps one of the common habit noticed all over Asia including India and Far Eastern countries to be specific. It commonly called Paan in almost all Indian languages besides Tambul, the second name being derived from Sanskrit. In Atharva Veda it is referred to as Saptashira since there are seven noticeable veins or shira on all its leaves. In botanical nomenclature it is called Piper betle Linn , belonging to Piperaceae botanical family

The plant is a type of creeper which is usually cultivated in vines. There are various types of betles all having same botanical name but varies in taste which are called commercially in India as Bangla patti, Mitha patti, Madras patti etc. Chemically and analytically however these varieties do not vary much.

Betle leaves yield 0.7 per cent essential oil. It yields enzymes which helps in our digestion. Above all these leaves yield vitamins such as ascorbic acid and phenolic compounds such as Chavicol and hydroxychavicol. It also yields Vitamin B.

The betle is normally taken with lime which contains calcium hydroxide, Katha containing catechin or acacatechin and betle nut or Supari containing mainly catechin, arecolins and some such alkaloids. When all these are chewed together a red pigment is formed which makes lips red. This combination was our ancient lipstick. Besides the reaction of alkalinity of lime and arecoline of betle nut influences our nervous system in such a way that it brings a happy mood. It may be mentioned that like any other leaf betle leaf is also acidic. If lime is used upto the extent neutralising the acidity, the taste will be further accentuated.

There is a long list of good qualities of this leaf. Since it contains Vitamins it can be used as tonic. Besides the leaf is also anthelmintic, laxative, carminative, stimulant and aphrodisiac. It acts well for cure of bronchitis, leprosy, asthma, elephantiasis, alcoholism, poisoning and loss of consciousness. It also acts as a good expectorant, and relieves diphtheria besides bringing back lost appetite.

The juice of betel leaf is used as medicine for tumours on gum, eczema and ear diseases. When this leaf is taken with seeds of tulsi plant, it increases sex vitality. The root of the betel plant can be used for preparation of birth control stimulants. It is believed that the leaf cleanses the throat and breathes and cures all diseases related to gum and lips. It has the capacity to improve peristaltic movement.

Betel leaves are applied externally also for various problems. The juice of the leaves if applied externally almost certainly removes the lice. The juice after heating often used as ear drops. For chronic ring worms or eczemas it can be applied externally effectively. The leaf is used for dressing septic wound as it has the capacity to take out the pus.

The plant has many bad qualities too. If taken with tobacco, the leaf is believed to cause cancer. If the leaf is consumed with stem and main vein, it attacks our nervous system. If we consume this leaf too much instead of improving the appetite it kills the appetite.

This creeper is being cultivated commercially in India, in certain pockets due to demand of its leaves. But many of its virtues are not being utilised. The leaves are not just meant for habitual consumption but is a medicine and tonic too. Its roots can help planing our family. The tragedy being its virtues are not used appropriately.

CHAPTER '33

LABALEE

Labalee is one of the commons wild grown plant that grows in the moist climate particularly in plains of North Eastern India, Bangladesh, West Bengal, Orissa, part of Bihar and part of South India. It is called Labalee or Labani in Sanskrit and Noad in Bengali. In botanical nomenclature it is known as *Phyllanthus distichus* Muell-Arg belonging to Euphorbiaceae botanical family.

The fruit of this plant is usually sour and sweet. It is normally utilised for preparation of chutneys. It is worth thinking therefore to utilise this fruit for preparation of jams and jellies using appropriate preservatives.

In the villages of Bangladesh and West Bengal, this plant was traditionally used for treatment of measles and chicken pox. For those who are already affected by above disease, the juice of the leaf of this plant is given for consumption and leaves are applied externally. It is also used externally for leprosy also.

The plant yields tannin, saponin, acids such as gallic acid, oxalic acid, malic acid etc., besides various amino acids. Due to presence of gallic acid, it can be used for dyeing the textiles. If they can be isolated, the plant can be utilised more effectively. The plant can also be used for tanning hides. This plant has the capacity to improve liver functions and believed to be a good expectorant.

Unfortunately, the plant is not considered useful even by local doctors nor much research has been done. As a result the plant is being felled frequently without releasing that when we shall come to know its virtues we shall reach a point of no return when we may not get a single plant for our use.

CHAPTER 134

TULSI

Tulsi is now considered as one of the most sacred plant considered by the Hindus of India. But it may be noted that it was not known to ancient Aryans but was adopted as sacred by them from non-Aryan tribes or Anyarans, particularly Austro-asiatics. Infact the term Tulsi was originally a Munda or Santhal term adopted by entire India. These plants are considered extremely important by the Ao Nagas who call these plants as Nangpara while Lotha Nagas call it Rarakham. It is also considered sacred by the people of Far Eastern Asia irrespective of their religious belief. These plants are also considered sacred by the people of Africa. In brief the plants may be considered as sacred in the oriental world and tropical world. By considering sacred, we have also associated a number of mythological legends and stories with this mint plant.

The Tulsi plants belong to Labiatae botanical family and *Ocimum* genus. There are a number of species found all over India. But most common are *Ocimum Sanctum* Linn. which is called sacred basil in English and Krishna Tulsi in Indian languages. This plant is identified by blackish green leaves. Medicinally it is considered to be most useful. The second variety is *Ocimum americanum* Linn. which is called Ban Tulsi. It is identified by comparatively larger leaves. The third variety is *Ocimum basilicum* Linn. which is called Babui tulsi or Dulal tulsi. The fourth variety is *Ocimum gratissimum* Linn. which is called Ram tulsi. It is the native of South Eastern Asia. The fifth variety is commercially most important. Botanically it is known as *Ocimum Kilimandscharicum* Guerin which is called Camphor basil or Karpur tulsi. It is believed to be native of Africa and originated near Mt. Kilimanjaro.

The tulsi plants in general yields phenolic constituents such as eugenol, methyl eugenol, carvacol and traces of phenol, Terpenoids such as citral, Citronellal, Citronellol, and Caryophyllene, traces of acids such as acetic acid besides of course camphor. All the tulsis yield essential oil.

Basilicum variety yields 0.16 to 0.60 per cent essential oil. Composition of this essential oil is methyl cinnamate 43.6 to 74.3 per cent, methyl Chavicol 6.5 to 24.3 per cent, Linalool 8.6 to 33.6 per cent and Ocimene 0.8 to 5.6 per cent. Gratissimum variety yields 0.27 per cent essential oil. The composition of this essential oil is 60.5 per cent eugenol, 19.4 per cent Ocimene, 10 per cent Cadinene besides 4 per cent 1-perillyl alcohol and 3 per cent 1-oadinene. Kilimandscharicum variety is usually cultivated in India commercially since it yields camphor or Karpur. Its leaves yield 6.13 per cent of camphor and camphor out of which nearly two third is camphor. Yield can be increased if in case of withered and shade dried leaves. Plants grown in Darjeeling yield essential oil 2.5 to 7.6 per cent of which 50 to 70 per cent camphor. Sanctum variety also yields essential oil besides citric, tartaric and malic acids. Essential oil yield of leaves being 3 to 5 per cent.

It is generally believed that the tulsi plants conveys electro magnetic influences. It is also believed that in a house situated close to a forest of tulsi is free from the diseases caused by virus infections. It is actually reported that one tulsi leaf is enough to make a few gallons of water virus and bacteria free. Tulsi leaf taken with honey and Zinger not only acts as expectorant but cures cough, cold and fever. About 5 to 7 tulsi taken with a tea spoon full of honey and a pinch of black pepper brings down eosinophilia of the blood and gives relief in breathing troubles. Tulsi leaf if taken regularly increases oxygen carrying capacity of the blood. Tulsi leaves are effective in case of eczema and asthma. Tulsi seed taken with betle leaf increases sex vitality. Roots of Sancum variety also can be used for the same purpose. Aquous extract of seeds of basilicum and gratissimum variety cures urinary diseases. For insect bites, or bee stinges external application of juice of tulsi leaf acts miracle. Ao Nagas used to use dry powder of tulsi leaf as snuff to bring back the senses in case any person faints. The juice of tulsi leaves if sucked

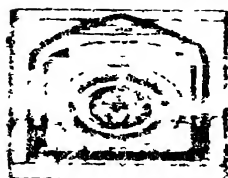
through, the nose cures nasal diseases. Dry powder of tulsi leaves also can be taken like snuff in case the noses are closed due to cold. By consuming juice of tulsi leaves regularly blood gets purified. In case of ear pains tulsi leaves are used effectively for hot foment. Tulsi leaves used just like tea ensures disease free life. Tulsi leaf with common salt applied externally cures ring worm. The leaves are also effective for heart diseases, and hyper tension. It is generally believed that this plant repels snakes, mosquitoes and makes the atmosphere bacteria and virus free.

One of the greatest advantage of this plant is, it grows almost all type of soil and climate without much care therefore it can be easily be grown in fallow lands. All types of tulsi can be cultivated commercially in such lands for the essential oil that it yields and for its medicinal values, above all to make the area disease free. Its juice or dried powder of leaves can be preserved and used for various disease. With so much of its virtues there is no reason why these plants can not be cultivated commercially to ensure a disease free future of our country.

BIBLIOGRAPHY

- (1) Bhattacharyaa, Ayurvedacharyaa Sibkali - "Chiranjib banooshadi" Part -I. (Ananda Publishers Pvt Ltd., Calcutta).
- (2) Chopra, R N., Nayar, S.L. and Chopra, I.C. "Supplement to Glossery of Indian medicinal plants (Publications and Information Directorate, CSIR, New Delhi).
- (3) Lakshminathan, V. (Ed) - "Tree borne oil seeds" (Directorate of NEOS Industry, Khadi and Village Industries Commission, Bombay).
- (4) Bailey, Alton E, - "Industrial oil and fat Products".
- (5) Helditch, T.P - "The industrial chemistry of Fats and Waxes".
- (6) Helditch, T P - "The Chemical constitution of Natural Fats".
- (7) Eckey, E.W. - "Vegetable fats and oils".
- (8) Wealth of India - Raw materials, Vol I to XI (A to Z) (CSIR, New Delhi).
- (9) Muralidhara, H.G - "A Panorama of the world of oils" (National Education Society, Shimoga).
- (10) Kallapur, S K. - "Bark and leaf fibres of India" (Directorate of Publicity, Khadi & V.I. Commission, Bombay).
- (11) Kallapur, S K - "Bamboos and Canes" (Khadi & Village Industries Commission, Bombay).
- (12) Maharathi, Upendra - "Venu shulpa" (Bihar Rastra Bhasa Parishad, Patna)
- (13) Thapar, S D. - "Indian Forest Resources" (Birla Institute of Scientific Research, New Delhi).
- (14) Qureshi, Dr I M., - "Bamboos in India" (Forest Research Institute, Dehra Dun).

- (15) Ghosh, G.K. - "Technology in Naga Tradition (Ayurvedic)" (Rastrabhasa Samabaya Prakasan, Cuttack).
- (16) Ghosh, G.K. - "From Mahua with love" (Unpublished article).
- (17) Ghosh, G.K. - "Tales of Snake Wood" (Ura Mail, Vol-XII No. 16 dt. 12 3.86, Dimapur).
- (18) Ghosh, G.K. - "En-rapport between God and Human" (Nagaland Times, Vol XVI No. 34 dt 5/3/86, Dimapur).
- (19) Ghosh, G.K. - "Let us remain less tense" (Ura Mail, Vol. XI No. 49 dt 16 10 85, Dimapur).
- (20) Ghosh, G.K. - "The love story" (Ura Mail, Vol-XI No. 3 dt 14 11 84, Dimapur).
- (21) Ghosh, G.K. (Ed) - "Fibre industry for human well being from nature's wealth" (Directorate of Fibre Industry, Khadi & Village Industries Commission, Bombay).
- (22) Ghosh, G.K. - "Nature - the neglected Wealth of Nagaland" (The Warrior dt October 1983, Vol. 12, No. 21 Published from Kohima).



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